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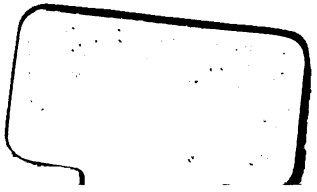

MOFFATT'S

PUPIL TEACHERS' COURSE.

EDITED BY

THOMAS PAGE.

FOURTH YEAR.

PRICE 5s.

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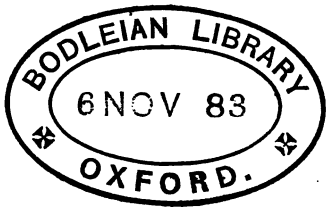

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NEW CODE—SCHEDULE V.

QUALIFICATIONS AND CERTIFICATES OF PUPIL TEACHERS AT THE END OF FOURTH YEAR.

1. **Certificates of character and good conduct.**

2. To **read** with fluency, ease, and just expression, and to **recite** 100 lines of Shakespeare or Milton, with clearness and force, and knowledge of meanings and allusions.

3. **English Grammar and Composition.**

(*a*) Fuller knowledge of *grammar* and *analysis.*

(*b*) The common *Latin roots* of English words.

(*c*) Outline of the *history of the language and literature.*

4. **Arithmetic.**

(*a*) *Males.* Arithmetic generally.

(*b*) *Females.* Applications of fraction and proportion to *interest, discount, percentages, averages,* and *stocks.*

5. **Geometry** (for males). Euclid, Book II., with simple deductions.

6. **Mensuration** (for males) of plane surfaces.

7. **Algebra** (for males). The same as for the previous year, and *cube root, simultaneous equations* of the first degree of two unknown quantities, and *quadratic equations* involving one unknown quantity, with easy *problems*.

8. **Geography** (*maps to be drawn in each year*).
(*a*) The *world* generally.
(*b*) The *seasons*, the *sun*, *moon*, and *planetary system*.
(*c*) The *tides*.

9. **English History.** The same period (from the accession of the Stuarts to the present time) in fuller detail.

10. **Teaching.** To give a collective or class lesson on any subject taught in the school.
To prepare *notes of a lesson*.

11 **Music** (*where suitable means of instruction exist*). The *minor scale* in its chromatic forms, and the chromatic intervals found in it.

GEOGRAPHY.

AMERICA.

The continent of America extends from the Arctic to the Antarctic Ocean, a distance of more than 9,000 miles. It is often termed the New World, from being unknown to Europeans before the great geographical discoveries of the 15th century. It consists of two immense masses of land, called North and South America respectively, and united by the Isthmus of Panama. America is the second largest in size of the great divisions of the world.

I. NORTH AMERICA.

SITUATION. North America forms the northern portion of the great continent of America. It lies between 72° and 8° north latitude, and between 45° and 168° west longitude. Its islands extend still farther to the north and east.

BOUNDARIES.

North, the Arctic Ocean.

West, the Pacific Ocean.

South, the Pacific Ocean and Isthmus of Panama.

East, the Caribbean Sea, Gulf of Mexico, and the Atlantic Ocean.

EXTENT.

Length: 5,600 miles, from Cape Lisburne in Alaska to the Isthmus of Panama.

Breadth: 3,120 miles, from Cape Canso in Nova Scotia to the mouth of the Columbia River.

600058954.

North Devon.
Melville Island.
Cockburn Island.
Prince Albert Land.
Prince of Wales Land.
Bathurst Island.

(2) IN THE PACIFIC OCEAN.
Prince of Wales Island.
Vancouver Island.
Queen Charlotte's Island.

(3) IN THE ATLANTIC.
West Indies.
Cape Breton Island.
Newfoundland.
Bermudas.
Prince Edward Island.

Greenland is an immense mass of unexplored land, which extends from the unknown Arctic regions in the north to Cape Farewell, at 60° north latitude. Its breadth is from six to seven hundred miles. Its surface is excessively sterile, and the cold is intense. Its coast is lined by vast accumulations of ice, some of which being broken off by the force of the wind and waves, become icebergs or floating masses of ice. Greenland has a few settlements on the coast, resorted to by those engaged in the whale and seal fisheries. It produces wild-fowl, reindeer, bear, fox, and other fur animals, and sea fowl. The inhabitants are principally Esquimaux, who dwell in rude huts, and live chiefly on fish and the flesh of the seal. The country is nominally subject to Denmark. Upernavik is remarkable as being the most northern town in the world.

SURFACE. The north and centre are generally flat. A continuous range of mountains extends from north to south, running parallel to the west coast, and forming with the Andes the longest chain in the world.

MOUNTAINS.

The Rocky Mountains, forming the northern portion of the

great western chain. Its highest peaks are Mount Brown, nearly 16,000 ft.; Mount Hooker, 15,000 ft.; and Mount Murchison, 15,000 ft.

The Cordilleras, in Mexico and Central America, forming the southern portion of the great western chain. Its highest points are Popocatapetl, 17,700 ft., and Orizaba, 17,500 ft.

The Cascade Mountains, in the Canadian Dominion, between the Rocky Mountains and the Pacific; highest point, Mount Hood, 12,000 ft.

The Coast Range, near the coast, extending from California to Alaska. The highest points are St. Elias, 17,500 ft., and Mount Fairweather, 14,500 ft.

The Alleghany Mountains, in the United States, running parallel with the east coast, and forming the eastern boundary of the basin of the Mississippi. The highest point is Mount Washington, 6,200 ft.

Ozark Mountains, west of the Mississippi. This is a low chain, rising to the height of about 2,000 ft.

PLAINS.

The Great Plain of North America. This extends from the Arctic Ocean to the Gulf of Mexico, a distance of about 3,000 miles. It is watered by the great rivers Mackenzie and Mississippi.

The Atlantic Coast Plain, between the Alleghany Mountains and the Atlantic Ocean.

TABLE-LANDS.

The Mexican Table-land, west of the Cordilleras.

The Plateau of Guatemala, a continuation to the south of the Table-land of Mexico.

The Table-land of Labrador.

RIVERS. North America is well watered. It contains the second largest river in the world.

(1) FLOWING INTO THE ARCTIC OCEAN.

Mackenzie, 1,900 miles. (*See* Colonies, "Pupil Teachers' Course. Year II.")

(2) FLOWING INTO THE PACIFIC OCEAN.

Frazer, 450 miles. (*See* Colonies.)

Columbia, or Oregon, 750 miles.

Sacramento, or Buonaventura, 420 miles, rising in the high lands of the Oregon territory, and flowing south-west into the Pacific. At its mouth is the town and harbour of San Francisco.

Colorado, 800 miles, rising in the Rocky Mountains, and flowing south-west into the Gulf of California. Its chief tributary is the Gila.

(3) FLOWING INTO THE GULF OF MEXICO.

Rio del Norte, or **Rio Grande del Norte**, 1,400 miles, rising in the Rocky Mountains, and flowing south-east into the Gulf of Mexico. It forms the boundary between the United States and Mexico.

Mississippi, with its tributary Missouri, 4,000 miles, the second largest river in the world. (*See* United States.)

Alabama, flowing south-west through the state of Alabama.

(4) FLOWING INTO THE ATLANTIC.

Savannah, 400 miles,
James, 450 miles,
Potomac, 400 miles,
Susquehanna, 450 miles,
Delaware, 300 miles,
Hudson, 300 miles,
Connecticut, 400 miles,

rising in the Alleghany Mountains, and flowing south-east through the United States into the Atlantic Ocean.

St. Lawrence, 2,000 miles. (*See* Colonies.)

(5) FLOWING INTO HUDSON'S BAY.

Little Whale River.
Great Whale River.
Albany.
Severn.
Nelson.
Churchill.

LAKES. North America contains the largest fresh-water lakes in the world.

Superior, 32,000 sq. m.
Huron, 25,000 sq. m.
Michigan, 20,000 sq. m.
Erie, 12,000 sq. m.
Ontario, 7,000 sq. m.

These five lakes form a connected group, the largest body of fresh water in the world. Lake Michigan lies in the United States; Superior, Huron, Erie, and Ontario are situated between the United States and the Canadian Dominion. Lake Superior is connected with Lake Huron by the River St. Mary. Lakes Huron and Erie are connected by the River and Lake of St. Clair and the River Detroit. Lakes Erie and Ontario are united by the River Niagara, which forms the celebrated Falls of Niagara, descending 164 feet, and artificially by the Welland Canal. Owing to their great size, these lakes are never entirely frozen over. They are connected with the sea by the River St. Lawrence.

Winnipeg, 9,000 sq. m.
Athabasca.
Great Slave Lake.
Great Bear Lake.

These are the largest of a great chain of lakes, extending from Lake Superior to the Arctic Ocean. (*See* Colonies, Dominion of Canada.)

Great Salt Lake, in Utah, United States.

Nicaragua, in Central America. This lake is connected with the Caribbean Sea by the River San Juan.

CLIMATE. North America has great diversities of climate. The northern parts are intensely cold. The southern parts are very hot, though the heat is modified by the narrowness of the continent, which brings it under the influence of the ocean. The western coast is warmer than the eastern. The central parts are colder than corresponding latitudes in Europe, owing to the flatness of the northern coast and consequent exposure to the Arctic winds. There is much rain in the tropical parts and in the vicinity of the great lakes. West of the Rocky Mountains the climate is dry.

SOIL. Generally fertile. The largest extent of fertile land is the basin of the Mississippi. Vast plains, covered with grass, and called *prairies* or *savannahs*, extend over the western portion of this region. These are gradually being brought under cultivation. The northern regions are barren, on account of the intense cold.

MINERALS. Abundant. The principal are—
Gold, in California, British Columbia, and Mexico.
Silver, in Mexico.
Precious Stones, in Columbia.
Copper, in Mexico, Canada, United States.
Tin, in Mexico.
Lead, in the United States and Mexico.
Quicksilver, in Mexico.
Iron, in the United States, Canada, and Mexico.
Coal, in Canada, United States.
Salt, in most parts, particularly in the salt lakes.
Petroleum, or rock-oil, in the United States and Canada.

ANIMALS. Abundant, but inferior in type to those of the Old World.

(1) **Wild Beasts.** Bear (polar and grizzly), bison, elk, wolf, fox, puma, reindeer, goat, beaver, opossum.

(2) **Domestic Animals.** Most of the European kinds have been introduced.

(3) **Birds.** Eagle, vulture, turkey, humming-bird.

(4) **Reptiles.** Alligator, rattlesnake, tortoise, turtle.

(5) **Insects.** Mosquito, bee, cochineal insect.

(6) **Fishes.** Cod, mackerel, salmon, herring, crab, oyster; whale, seal, walrus.

VEGETATION. Vast tracts are covered with forests, which are gradually being cleared off as the continent becomes settled.

(1) **Trees.** Pine, oak, mahogany, Wellingtonia gigantea, cedar, beech, elm, birch, maple.

(2) **Objects of Culture.** Cotton, tobacco, wheat, maize,

sugar-cane, rice, pomegranate, fig, orange, and other fruits; hemp, flax, hops, coffee, cocoa, indigo.

POPULATION. About 65,000,000. The following are the principal varieties of race inhabiting North America:—

(1) **Europeans,** in the United States and the British Colonies, Cuba, Mexico.

(2) **Negroes,** in the United States and the West Indies.

(3) **Indians,** or Red Men, inhabiting the unsettled parts of the centre and west. They have a copper-coloured skin, are divided into many tribes speaking different languages, and live chiefly by hunting. They are often at war with each other and with the European settlers. They are gradually disappearing before the advance of the white men.

(4) **Esquimaux,** in the north, near the shores of the Arctic Ocean and Baffin's Bay, and in Greenland.

(5) **Mixed Races,** formed by the marriage of Europeans with negroes and native Indians.

DIVISIONS.

British Possessions,	*capital*	Ottawa, on the Ottawa.
Greenland,	„	Julianshaab.
United States,	„	Washington, on the Potomac.
Mexico,	„	Mexico.
Central America,	„	Guatemala, etc.

West Indies (which may conveniently be taken with North America).

BRITISH POSSESSIONS.

(*See* Colonies.)

GREENLAND.

(*See* p. 6.)

UNITED STATES.

I. PHYSICAL.

BOUNDARIES.

North, the British Possessions. The greater part of the boundary between the United States and the British Posses-

sions is formed by the great lakes, and (west of the Lake of the Woods) by the 49th parallel of north latitude.

West, the Pacific.

South, Mexico and the Gulf of Mexico.

East, the Atlantic.

EXTENT.

Length, 2,500 miles. *Breadth*, 1,700 miles.

Area, 3,000,000 sq. m., or, including the North-western Territory (Alaska), 3,600,000 sq. m.

COAST. Extensive, stretching along the Atlantic Ocean, the Gulf of Mexico, and the Pacific. The length of coast is about 40,000 miles.

BAYS, GULFS, etc.

(1) CONNECTED WITH THE ATLANTIC.

Massachusetts Bay, Long Island Sound, Delaware Bay, Chesapeake Bay, Albemarle Sound, Pamplico Sound.

(2) CONNECTED WITH THE GULF OF MEXICO.

Tampa Bay, Appalachie Bay, Chandeleur Bay, Galveston Bay.

(3) CONNECTED WITH THE PACIFIC.

San Francisco Harbour.

For Straits and Peninsulas, *see* general description of North America.

CAPES.

(1) ON THE EAST COAST.

Cape Cod, Cape May, Cape Charles, Cape Hatteras, Cape Lookout, Cape Fear.

(2) ON THE SOUTH COAST.

Cape Sable, Cape Roman, Cape St. Blas.

(3) ON THE WEST COAST.

Point Concepcion, Cape Mendocino, Cape Blanco, Cape Flattery.

ISLANDS. A few small and unimportant islands lie off the coast. The principal are **Nantucket Island, Rhode Island, Long Island,** all in the Atlantic.

SURFACE. The United States is divided into three clearly defined regions.

(1) **The Great Central Plain,** between the Rocky Mountains on the west and the Alleghany Mountains on the east, watered by the Mississippi and its tributaries.

(2) **The Eastern Plain,** or the Plain of the Atlantic, extending from the Alleghany Mountains on the west to the Atlantic on the east.

(3) **The Western Table-land,** or the **Great Basin,** extending from the Rocky Mountains on the east to the Pacific on the west.

MOUNTAINS.

The Rocky Mountains, extending through the greater part of North America, parallel with the west coast. Its greatest elevations are in British North America. In the United States are *Long's Peak*, 14,300 ft., *Fremont's Peak*, and *James's Peak.*

Alleghany Mountains, in the east, parallel to the Atlantic, also called the Appalachian Mountains. The highest points are *Mount Washington*, 6,200 feet, and the *Otter Peaks*, 4,200 ft.

Ozark Mountains, crossing the Great Plain west of the Mississippi, and rising to a height of 2,000 ft.

RIVERS.

(1) FLOWING INTO THE ATLANTIC.

Connecticut, 400 miles, flowing south through Vermont, Massachusetts, and Connecticut into Long Island Sound. On its banks is the city of Connecticut.

Hudson, 300 miles, flowing south through the state of New York into New York Harbour. On its banks are Albany, Hudson, and New York.

Delaware, 300 miles, flowing south between Delaware and New Jersey into Delaware Bay. On its banks are Trenton and Philadelphia.

Susquehanna, 450 miles, flowing south through Pennsylvania and Maryland into Chesapeake Bay. On its banks is Harrisburg.

Potomac, 400 miles, flowing south-east between Virginia and Maryland into Chesapeake Bay. Its chief tributary is the Shenandoah. On its banks is Washington, the capital of the United States..

James, 450 miles, flowing east through Virginia into Chesapeake Bay. On its banks is Richmond, capital of Virginia.

Roanoke, 350 miles, flowing south-east through Virginia and North Carolina into Albemarle Sound.

Pedee, 350 miles, flowing south-east through North and South Carolina into the Atlantic. Near its mouth is Georgetown.

Savannah, 400 miles, flowing south-east between South Carolina and Georgia into the Atlantic. Near its mouth is Savannah.

Altamaha, 400 miles, flowing south-east through Georgia into the Atlantic.

(2) FLOWING INTO THE GULF OF MEXICO.

Chaldhooche, 500 miles, flowing south between Georgia and Alabama and through Florida into the Gulf of Mexico.

Alabama, 500 miles, flowing south-west through Alabama into the Gulf of Mexico. Its mouth is called Mobile Bay.

Mississippi, with its tributary the Missouri 4,000 miles long; the second largest river in the world, and often denominated the "Father of Waters." The Mississippi rises in the small lake Itasca, in Minnesota, near the northern boundary of the United States. The rivulet which issues from that lake is fed by numerous streams which proceed from many other lakes in the vicinity. The course of the River Mississippi is in a generally southern direction during the whole of its length. It flows through Minnesota, then between Iowa, Missouri, Arkansas, and Louisiana on the right bank, and Wisconsin, Illinois, Kentucky, Tennessee, and Mississippi on the left bank, and finally, passing through Louisiana, it empties itself by many mouths, forming a swampy delta, into the Gulf of Mexico. The length of the Mississippi proper is about 2,500 miles.

Its great tributary, the **Missouri,** rises in the Rocky Mountains, in the state of Nebraska, issues by a narrow gorge from

the mountain-chain, flows north and east, then turns south-east, forming the boundary between Nebraska and Kansas on the right and Minnesota, Iowa, and Missouri on the left, and then, passing through the state of Missouri, joins the Mississippi near St. Louis.

The basin of the Mississippi covers an area of about 2,000,000 square miles.

Tributaries: The Missouri receives (on the right bank) the Yellowstone, the Platte, and the Kansas.

The chief tributaries of the Mississippi are (on the right bank) Missouri, Arkansas, Red River; (on the left bank) Illinois, Ohio (with its tributaries Wabash and Tennessee).

Towns: (On the Mississippi) Burlington, St. Louis, Memphis, Helena, Vicksburg, Natchez, New Orleans; (on the Missouri) Jefferson City; (on the Ohio) Pittsburg, Cincinnati, Louisville; (on the Tennessee) Florence; (on the Arkansas) Arkopolis, or Little Rock; (on the Red River) Natchitoches.

Rio del Norte, 1,400 miles. (*See* North America.)

(3) FLOWING INTO THE PACIFIC OCEAN.

Colorado, 800 miles.
Sacramento, 420 miles. } (*See* North America.)
Columbia, 750 miles.

LAKES. In the north are the five great lakes; namely,

Superior, Huron, Michigan, Erie, Ontario. (*See* General Description of North America.)

Great Salt Lake, in Utah.

Lake Champlain, between New York and Vermont.

There are vast numbers of lakes, some of considerable size, especially in the western states; but they are situated in the unsettled parts of the country, and are little known.

CLIMATE. Various, according to the situation. In the north-east the climate is similar to that of England. In the northern part of the great plain, the summers are hot, and the winters very cold. The south is hot. The region west of the Rocky Mountains is dry. The climate is humid near the lakes.

SOIL. Fertile, except in the mountainous districts.

MINERALS. Abundant and valuable. **Gold** (in California), **silver** (in Nevada), **iron, coal, copper, lead, tin, salt. Petroleum,** or rock-oil, is abundant.

WILD ANIMALS. Most of the North American varieties are found; **bear, wolf, bison, fox,** etc.

FORESTS. The forests east of the Mississippi produce valuable timber, as **beech, oak, elm, birch, maple, ash.** West of the Mississippi are the vast plains called **prairies,** covered with rank grass.

II. POLITICAL.

AGRICULTURE. This is the chief employment of the people. It is in a flourishing condition, and rapidly increasing in extent and improving in quality. The soil and climate are favourable, and agricultural machines of every kind are invented and employed in the cultivation of the ground.

Objects of culture: Corn (maize, wheat, etc.), cotton, tobacco, rice, sugar-cane, flax, hemp.

Most kinds of European **domestic animals** are found. Cattle are reared in vast numbers; horses, sheep, pigs, are abundant.

Butter and cheese are produced in immense quantities.

MANUFACTURES. Extensive, and rapidly increasing. The manufactures are chiefly carried on in the more settled states near the east coast. **Cotton, iron, and woollen goods; linen, leather, soap, ship-building.**

The chief **occupations** of the people are agriculture, manufactures, mining (gold, silver, coal, iron, lead), and fishing (cod, herring, whale).

COMMERCE. Very important, and rapidly increasing. The commerce of the United States ranks next to that of Great Britain in extent and importance. The trade is chiefly with Great Britain, the British Colonies, Brazil, Germany, Cuba, France.

Imports. Manufactured goods (cotton, woollen, linen, hardware, silk, wine), sugar, coffee, tea.

Exports. Raw cotton, wheat, flour, rice, tobacco, timber, cheese, beef, pork, horses, furs, gold.

Ports. New York, Boston, Philadelphia, Baltimore, Charleston, New Orleans, Mobile, San Francisco.

INTERNAL COMMUNICATION. Very good in the settled part of the country. There are numerous railways, canals, and highways. The great lakes and rivers are traversed by steamboats.

There is railway communication across the entire breadth of the continent, from New York to San Francisco.

POPULATION. Nearly 50,000,000. The population at the last census, in 1870, was 38,500,000.

The eastern, or New England, States are the most settled, and therefore the most populous.

The United States are peopled chiefly by colonists from Europe and their descendants. The principal races to be found in this country are

(1) **Europeans,** from Great Britain, Ireland, Germany, France.

(2) **Negroes,** formerly slaves, numbering about 5,000,000, and living principally in the southern States.

(3) **Indians,** found chiefly in the centre and west.

4) **Chinese,** in the Pacific States.

RELIGION. There is no Established Religion. The majority of the people belong to various Protestant bodies, as Wesleyans, Baptists, Episcopalians, Presbyterians. Roman Catholics are numerous. There are many Quakers in Pennsylvania. In Utah, near the Great Salt Lake, the Latter Day Saints or Mormonites have formed a considerable settlement.

GOVERNMENT. A Federal Republic, consisting of—

(1) **A President,** elected for four years. He is the head,

of the Executive, has the power, in conjunction with the Senate, of declaring war, making treaties, and conducting the foreign affairs of the Union. He can reject any measure passed by the Congress; but if the latter should again pass it by a majority of two-thirds, it becomes law without the President's consent.

(2) **A House of Senators,** chosen for six years (one-third of the whole number every two years). The legislature of each state elects two senators.

(3) **A House of Representatives,** elected for two years by the citizens of each state according to its population.

The legislative power is vested in the Houses of Senators and Representatives, which together form the Congress. The members of Congress are paid for their services.

Each state of the Union is independent in the management of its own internal affairs.

This country was formerly subject to Great Britain, but became independent in 1783.

The southern States endeavoured to secede from the Union in 1860, but after a dreadful civil war, which raged till 1865, they were compelled to acknowledge the authority of the general government, and slavery was abolished.

The **National Debt** amounts to about £450,000,000, contracted almost entirely during the civil war.

The **Army** is small; but the **Navy** is considerable.

The **Education** is good. Public Schools are established by the different states, and there are several Universities.

FOREIGN POSSESSIONS.

The District of Alaska, in the north-west of North America; formerly Russian America. Its *area* is about 500,000 square miles. It was purchased by the United States in 1866. It is a vast, desolate region, very thinly peopled. It is used as a hunting and fishing ground. Seals, otters, and other fur animals are caught.

DIVISIONS.

(*a*) **39 States.**

Maine (1).	* North Carolina (5).	Michigan.
* New Hampshire (1).	* South Carolina (5).	Wisconsin.
Vermont (1).	* Georgia (6).	Illinois.
* New York.	Florida.	Iowa.
* Massachusetts (1).	Alabama.	Minnesota.
* Rhode Island (1).	Mississippi.	Nebraska.
* Connecticut (1).	Louisiana (7).	Oregon.
* New Jersey.	Arkansas.	California.
* Pennsylvania (2).	Tennessee.	Nevada.
* Delaware.	Missouri.	Colorado.
* Maryland (3).	Kentucky.	New Mexico.
* East Virginia (4).	Ohio.	Kansas.
* West Virginia (4).	Indiana.	Texas.

NOTES.—(1) New England States.
(2) Named from its founder, Penn, the Quaker.
(3) Named from Henrietta Maria, wife of Charles I.
(4) Named after Queen Elizabeth, the "Virgin Queen."
(5) Named after Charles II. (Carolus.)
(6) Named after George II.
(7) Named after Louis XIV. of France.

The thirteen States which declared themselves independent in 1776 are marked thus (*). Virginia was a single State till 1863.

(*b*) **1 Federal District.**
Columbia.

(*c*) **7 Organized Territories.**

Washington.	Idaho.
Utah.	Montana.
Dacota.	Wyoming.
Arizona.	

(*d*) **2 Unorganized Territories.**
Indian Territory. Alaska.

TOWNS.

New York. Population, 1,200,000, or, with its suburb, Brooklyn, 1,700,000. Largest city in America. Situated in the State of New York, on the island of Manhattan, at the mouth of the River Hudson. Brooklyn is situated opposite to New York, on

Long Island. Great port, with immense trade. Finely built, with large public buildings and wide streets. The finest street is Broadway, three miles long. Named after the Duke of York, afterwards James II.

Philadelphia, in Pennsylvania. Population, 840,000. Situated near the River Delaware. Second city of the United States in population. Extensive manufactures and great trade. A handsome city, regularly built. "Declaration of Independence" made here in 1776. Head-quarters of the Quaker population.

Chicago, in Illinois, near Lake Michigan. Population, 480,000. Great trade. Remarkable for its rapid increase from a small to a very large town in a few years. Almost destroyed by fire in 1871.

St. Louis, in Missouri, on the Mississippi. Population, 375,000. Great seat of the central trade of the United States.

Boston, in Massachusetts, on the coast. Population, about 350,000. Large port, with good harbour, and great trade. A beautiful city, the centre of American culture, with numerous literary and scientific institutions. The Revolution, which caused the separation of the colonies from Great Britain, broke out here in 1773. Battle of Bunker's Hill fought in the neighbourhood, 1776. At Cambridge, three miles distant, is the celebrated Harvard University.

Baltimore, in Maryland, near Chesapeake Bay. Population, 330,000. A large port, with great trade, and important manufactures.

Cincinnati, in Ohio, on the River Ohio. Population, about 255,000. Beautiful city, with great trade.

San Francisco, in California, near the mouth of the Sacramento. Population, about 227,000. Chief town and port on the Pacific coast, with great trade. Railway communication complete between it and the Eastern States by means of the Union Pacific Railway across the Rocky Mountains. Great varieties of races found here; many Chinese.

New Orleans, in Louisiana, near the mouth of the Missis-

sippi. Population, about 207,000. Great port, with immense trade, especially in cotton, and other agricultural produce. Unhealthy situation on the low swampy delta of the great river; fever prevalent. Besieged and taken by the Federals, under Admiral Farragut, during the civil war.

Washington, in the District of Columbia, on the River Potomac. Population, 160,000. Capital of the United States. Contains the "White House," where the President resides, and the Capitol, where the Congress assembles. Named after the General Washington.

Buffalo, in New York, on the shores of Lake Erie, at the commencement of the Erie Canal. Population, 150,000. Great emporium of trade between the United States and the Canadian Dominion.

Pittsburg, in Pennsylvania, on the Ohio. Population, 100,000. Considerable manufactures; principally hardware. Sometimes called the "Birmingham of America."

Richmond, in East Virginia, on the James River. Population 50,000. Capital of the Confederate (Southern) States during the civil war. Occupied by General Grant, commander-in-chief of the Federal (Northern) forces, after severe fighting, in 1865. This event brought the war to a close.

Charleston, in South Carolina. A considerable seaport on the east coast. Taken by the English troops under General Clinton, during the War of American Independence, in 1780. Taken by the Confederates in 1861. This blow was the commencement of the great civil war. Re-taken by the Federals, under General Sherman, in 1865.

Savannah, a port in Georgia, near the mouth of the River Savannah. Taken by the Federals, under General Sherman, after his famous march from Atlanta, across the Southern territory, 1864.

Vicksburg, on the Mississippi; taken by the Federals, under General Grant, in 1863.

Great Salt Lake City, in Utah. Capital of the Latter-Day Saint community.

Plymouth, a small port in Massachusetts, famous as the spot where the Pilgrim Fathers landed from the *Mayflower*, in 1620.

Lowell, in Massachusetts; seat of the cotton manufacture.

Portland, a seaport in Maine.

Albany, in New York, on the Hudson. A large town, with considerable trade.

Mobile, in Alabama. A considerable seaport.

Newark (in Pennsylvania), **Louisville** (in Kentucky), **Cleveland** (in Ohio), **Jersey City** (in New Jersey), **Detroit** (in Michigan), **Milwaukie** (in Wisconsin), **Providence** (in Rhode I.), **Newhaven** (in Connecticut), **Rochester** (in New York), **Troy** (in New York), **Indianopolis** (in Indiana), **Worcester** (in Massachusetts), **Memphis** (in Tennessee), **Hartford** (in Connecticut), **Kansas City** (in Kansas), **Utica** (in New York), **Springfield** (in Illinois), **Nashville** (in Tennessee), **Salem** (in Oregon), **Oswego** (in New York), **Trenton** (in New Jersey), **Saratoga** (in New York), are other important towns.

MEXICO.

BOUNDARIES and EXTENT.

North, the United States.

South, the Pacific.

West, the Pacific.

East, Central America and the Gulf of Mexico.

Area, 750,000 sq. m.

COAST. Very extensive, stretching along the Pacific Ocean and the Gulf of Mexico.

SURFACE. Occupied chiefly by the chain of mountains called the **Cordilleras**, a continuation of the Rocky Mountains, and by extensive table-lands. The highest summit is *Popocatapetl*, the loftiest mountain in North America. There is a small extent of low land along each coast. Mexico is not well watered. The chief river is the **Rio del Norte**, which forms the boundary between Mexico and the United States. The largest lake is **Chapala** (650 sq. m.), situated on the Mexican table-land.

CLIMATE. Temperate, owing to its elevation, and dry. The lowlands near the coast are hot.

NATURAL PRODUCTIONS. Mexico contains extensive **forests,** which shelter vast numbers of wild animals of the usual North American species, and produce splendid timber; mahogany, rosewood, satinwood, ebony, logwood. Tropical fruit trees abound.

Mexico is very rich in **minerals.** Gold, silver, copper, tin, quicksilver, lead, iron, and precious stones are found in great abundance.

AGRICULTURE. In a very low state, owing to the mountainous character of the surface, the paucity of inhabitants, and the disorganized condition of the country.

The chief **objects of culture** are maize, wheat, banana, sugar-cane, cotton, tobacco, coffee, cocoa, indigo, southern fruits.

Horses and cattle are reared in great numbers.

MANUFACTURES. Unimportant. Coarse cotton and woollen goods, soap, and gold and silver ornaments are manufactured to a limited extent.

The chief occupation of the people is mining.

COMMERCE. Not extensive; chiefly with the United States and Great Britain. The **internal communication** is very defective; there are few railways, the roads are very bad, and deficient in number.

Imports. Manufactured goods.

Exports. Gold, silver, quicksilver, copper, drugs, cochineal, hides, cattle, timber.

Ports. (On the Gulf of Mexico) Vera Cruz, Tampico, Campeachy; (on the Pacific) Acapulco, Mazatlan, San Blas.

POPULATION. About 9,000,000, consisting chiefly of Indians, Europeans (of Spanish descent), and mixed races.

RELIGION. Roman Catholic.

GOVERNMENT. **A Federal Republic,** similar to that of

the United States, with a President, Senate, and House of Representatives.

Mexico appears to have attained to a high degree of civilization in ancient times, if we may judge from the interesting remains of antiquity which have been discovered in various parts. It was discovered by Cortes in the 16th century. It fell into the hands of the Spaniards, who held it till 1822, when it became independent. Mexico was ruled by an Emperor till 1824, when it was proclaimed a Federal Republic. The country is in a very unsettled state.

DIVISIONS. 27 States; 1 Territory; 1 Federal District.

TOWNS.

Mexico, on a tableland in the interior, 7,500 ft. above the sea. Capital of Mexico. Population, 200,000. A fine, well built city, with splendid cathedral. Seat of considerable trade; mining and other industries carried on.

Vera Cruz, on the shores of the Gulf of Mexico. Chief port, with considerable trade. The situation is unhealthy; yellow fever is prevalent. Connected by railway with the capital.

Guadalajara, on the River Santiago. Population, 80,000.

Puebla, a large town to the south-east of the capital.

Tampico, a considerable port on the Gulf of Mexico.

San Luis, Potosi, Durango, Oaxaca, Queretaro, etc.

CENTRAL AMERICA.

This is a general name for the region extending from Mexico to the isthmus of Panama. It is bounded on the east by the Caribbean Sea, and on the west by the Pacific.

Its **surface** is mainly a continuation of the chief mountain ranges and tableland of Mexico. The **Plateau of Guatemala** is the principal physical feature of this portion of America. It extends across the greater portion of the country, and attains an elevation of about 6,000 ft.

This region is well watered by numerous **rivers,** but they

are small, owing to the narrowness of the countries through which they flow.

The **climate** generally resembles that of Mexico, but it is more humid and more favourable to agricultural pursuits.

There are extensive **forests**, and abundant **mineral wealth**.

Central America is divided into six parts.

(1) GUATEMALA.

This State lies to the north.

Its *area* is about 45,000 sq. m.

Its **surface** is mountainous; the greatest elevation is Mt. Amilpas, 13,000 ft., an active volcano. It has numerous small rivers, and several lakes.

It is rich in **forests** and **mineral productions**.

It has much fertile land, but the **agriculture** is in a defective condition.

The chief **exports** are: cochineal, coffee, sugar, cocoa, tobacco, fruits, timber.

The **government** is a Republic.

The **population** is about 1,200,000.

TOWNS.

New Guatemala, a well-built town on a elevated plain, 4,500 ft. high. Capital of Guatemala. Population, 40,000. In the neighbourhood is Old Guatemala, the former capital, destroyed by earthquakes.

Istapa, a port on the Pacific.

St. Thomas, a port on the Gulf of Honduras.

(2) BELIZE, OR BRITISH HONDURAS.

See Colonies.

(3) SAN SALVADOR.

Area, 7,500 sq. m.

Its **surface** is a continuation of the plateau of Guatemala, and it has a similar climate and soil.

Its **productions** are like those of Guatemala. It is somewhat better cultivated.

Its **government** is a Republic.

Its **population** is about 600,000.

TOWNS.

San Salvador. Population 20,000. Capital of San Salvador, and formerly capital of the Federal Union of the Central American Provinces, which was broken up in 1839.

Acajutla, Libertad, ports on the coast.

(4) HONDURAS.

Area, about 45,000 sq. m.

Its **surface** is mountainous, but it has much fertile land. Its vegetables and mineral productions are similar to those of the other Central American States.

Its chief **exports** are timber and metals.

Its **government** is a Republic.

Its **population** is about 350,000.

TOWNS.

Comayagua. Population 20,000. Capital of Honduras.

Omoa, Truxillo, ports on the Gulf of Honduras.

(5) NICARAGUA.

Area, 60,000 sq. m.

It has **coast lines** on the Caribbean Sea and on the Pacific. The eastern coast, together with its continuation into Honduras, is called the Mosquito Coast, or Territory.

Its **surface** resembles that of the other Central America States. Its table-lands are somewhat lower than those farther north, and it has more level country. It contains two large **lakes, Nicaragua** and **Leon,** which are united by a small river. The **River San Juan** connects Lake Nicaragua with the Caribbean Sea.

Its **productions** are: timber (mahogany, etc.), dye-woods, sugar, coffee, cotton, tobacco, indigo, cocoa, and tropical fruits. It contains valuable **metals** which are at present little worked.

Its **government** is a Republic.

Its **population** is about 250,000.

TOWNS.

Managua, the capital. A small town near a lake of the same name.

Leon. Population, 25,000. The largest town, and former capital. Situated in the interior.

Granada, a town near Lake Nicaragua.

Realejo, a port on the Pacific coast.

Nicaragua, a town near the lake of the same name.

(6) COSTA RICA.

Area, 20,000 sq. m.

This state extends from Nicaragua to the Isthmus of Panama.

It contains much fertile land, a great deal of which is covered with **forests.** Cattle are extensively reared.

Its **productions** are: timber, coffee, sugar, cocoa, indigo, tobacco, precious metals, hides.

Its **government** is a Republic.

Its **population** is about 200,000.

TOWNS.

San Jose, on the coast of the Pacific. Capital and chief port. Population, about 20,000.

Cartago, a town in the interior.

Punta Arenas, a port on the Pacific.

Matina, a port on the Caribbean Sea.

WEST INDIES.

This is the name given to the immense system of islands lying between North and South America. They extend in a graceful curve from the peninsula of Florida to the coast of South America, near the mouths of the Orinoco, enclosing the Gulf of Mexico and the Caribbean Sea, of which they form the eastern boundary.

They derived their name from the erroneous idea entertained by Columbus that he had arrived at the vicinity of India when he first discovered land in the Bahama Islands, 1492.

The **climate** is generally tropical, modified by the influence of the sea, which renders these islands more temperate than countries in the same latitude. Much rain falls in the rainy

season, from July to October. Hurricanes are frequent, and in some of the islands fever is prevalent.

The chief **productions** are sugar, coffee, cotton, ginger and other spices, indigo, cocoa-nuts, oranges and other fruits, timber, turtles, etc.

The islands are extremely numerous. Many of them are of very small size. The four largest are **Cuba**, 43,000 sq. m.; **Hayti**, or **San Domingo**, 30,000 sq. m.; **Jamaica**, 6,000 sq. m.; **Porto Rico**, 4,000 sq. m.

NATURAL DIVISIONS.

(1) **The Antilles**, extending from the western extremity of Cuba to the coast of South America. They consist of

(*a*) THE GREATER ANTILLES, which includes Cuba, Hayti, Jamaica, Porto Rico and the smaller adjacent islands.

(*b*) THE LESSER ANTILLES, extending from Porto Rico to Trinidad. They include

(i.) *The Virgin Islands*, in the north.

(ii.) *The Leeward Islands*, in the centre.

(iii.) *The Windward Islands*, in the south.

(2) **The Bahamas**, lying to the north of the Greater Antilles, from which they are separated by the Old Bahama Channel.

POLITICAL DIVISIONS.

(1) **British Possessions.**
(2) **Spanish Possessions.**
(3) **French Possessions.**
(4) **Dutch Possessions.**
(5) **Danish Possessions.**
(6) **Swedish Possession.**
(7) **Independent.**

I. BRITISH POSSESSIONS.

(*See* Colonies, "Pupil Teachers' Course, Second Year.")

II. SPANISH POSSESSIONS.

(1) **CUBA.** This magnificent island, sometimes called the **Queen of the Antilles**, is by far the largest of the West Indies.

Its *length* is about 730 m. *Area*, 43,000 sq. m. Its *most western point* is Cape San Antonia; *most eastern*, Cape Maysi.

Its **surface** is generally mountainous, but there is much level and fertile land. A mountain chain traverses the island from west to east, rising to a height of about 8,000 ft. at its highest part. The rivers are small and unimportant.

The **climate** is hot and dry, but the heat is not so oppressive as in most countries in the same latitude.

The **forests** produce splendid timber; mahogany, ebony, cedar, etc.

Minerals are abundant, but little worked. Copper, iron, gold, and silver are found.

The chief **objects of culture** are: sugar, tobacco, coffee, rice, maize, cotton, indigo. Oranges, lemons, melons, pine-apples, and other tropical fruits are produced in abundance. Oxen, horses, and pigs are reared to a considerable extent.

The **commerce** is extensive, carried on chiefly with Great Britain, Spain, and the United States. The chief **exports** are sugar, molasses, coffee, tobacco, cigars, fruits, mahogany, rum, copper.

The **population** is about 1,400,000, of whom about one-half are slaves.

Cuba was discovered by Columbus in 1492. It was taken possession of by Velasquez in 1511, and has belonged to Spain ever since. Frequent attempts have been made by the inhabitants to gain their independence.

The **CHIEF TOWNS** are; (1) **Havannah.** Population 200,000. Capital, chief port, and largest town in the West Indies. It has a fine harbour and great trade. Havannah is famous for the manufacture and exportation of cigars. (2) **Puerto Principe,** an inland town, with a population of about 50,000. (3) **Matanzas**; (4) **San Juan**; ports on the north coast. (5) **Santiago de Cuba**; (6) **Trinidad**; ports on the south coast.

(2) **PORTO RICO.** This large island lies to the east of Hayti. Its *area* is about 4,000 sq. m.

Its **surface** is mountainous, but there is much fertile land. The mountains rise to the height of about 3,500 feet.

The **climate** and **natural productions** are similar to those of Cuba.

The **commerce** is chiefly with Spain and the United States. The chief **exports** are; sugar, molasses, coffee, rum, tobacco, fruits.

The **population** is about 500,000, of whom more than one-half are slaves.

The **LARGEST TOWN** is **San Juan,** which is the capital, and chief port. Its population is about 30,000. It is situated on the north coast, and has a good harbour.

(3) A few of the **Virgin Islands** also belong to Spain.

The Spanish West India Islands form the only remains of the once vast American possessions of Spain.

III. FRENCH POSSESSIONS.

(1) **GUADALOUPE,** in the Leeward Islands. It consists of two islands, divided by a channel called the Salt River. The eastern island is called **Grande Terre,** and the western **Basse Terre.**

The *area* is about 550 sq. m. Several other small adjacent islands also belong to France.

The **surface** is mountainous. The most remarkable eminence is a volcano called La Souffrière (Sulphur Mt.), 5,500 feet.

The chief **productions** are; sugar, molasses, coffee, tobacco, rum.

The **population** is about 150,000.

Guadaloupe has several times fallen into the hands of the English, but it was finally ceded to France in 1814.

The **CHIEF TOWNS** are, (1) **Basse-Terre,** the capital, and (2) **Point-à-Pitre,** the largest town and chief port.

(2) **MARTINIQUE,** one of the most northern of the Windward Islands.

Its *area* is about 400 square miles.

The **surface** is mountainous. There are several summits of volcanic origin. There is much level and fertile land.

The chief **productions** are; sugar, molasses, coffee, cocoa, cotton, rum. There is a considerable trade with France.

The **population** is about 140,000, mostly negroes.

Martinique has several times fallen into the hands of the English, but it was finally ceded, with Guadaloupe, to France in 1814.

The chief **TOWNS** are (1) **St. Pierre**, population, 20,000; the capital and chief port; (2) **Fort Royal**, on the south coast.

IV. DUTCH POSSESSIONS.

(1) **CURAÇOA.** This island lies in the Caribbean Sea, near the coast of South America. It does not properly belong to the West Indies.

Its *area* is about 150 sq. m. Its surface is mountainous; there is little fertile land.

Its chief **productions** are; salt, sugar, tobacco, cattle, tropical fruits.

Its population is about 15,000.

The capital and chief town is **Willemstadt.**

(2) **ORUBA**, lying to the west of Curaçoa.

(3) **BONAIRE**, or **BUEN AYRE**, a rocky island to the east of Curaçoa.

(4) **SABA, ST. MARTIN, ST. EUSTATIUS**, three small islands in the Leeward Group.

V. DANISH POSSESSIONS.

SANTA CRUZ, ST. THOMAS, ST. JOHN. Three islands belonging to the group called the Leeward Islands. The largest is Santa Cruz, which has an area of about 110 sq. m. It is generally flat; the other two islands are rocky and barren.

The **productions** are sugar, cattle, and fruits.

They have belonged to Denmark since 1814.

The **CHIEF TOWNS** are; (1) **Christianstadt**, the capital; (2) **Frederickstadt**, both in Santa Cruz; (3) **St. John**; (4) **St. Thomas**, each in the island of the same name.

VI. SWEDISH POSSESSION.

ST. BARTHOLOMEW, one of the Leeward Islands.

Its *area* is 25 sq. m. and population about 10,000, chiefly negroes.

It is hilly and generally barren. It **produces** sugar, cotton, indigo, cattle, salt, fruits.

Its **CHIEF TOWN** is **Gustavia**, the capital and port.

VII. INDEPENDENT.

HAYTI, called also **SAN DOMINGO** and **HISPANIOLA** (Little Spain), is the second largest of the West India islands. It is divided from Cuba by Windward Passage and from Porto Rico by Mona Passage.

Its *area* is about 30,000 sq. m.

The centre is mountainous. The highest range is called the **Mountains of Cibao**, which attain a height of about 8,500 feet. The plains are extensive and fertile, producing fine mahogany, and cedar and other trees, from which excellent timber is procured, and also tropical fruit-bearing trees. There is considerable **mineral wealth**, but it has hitherto been neglected.

The **climate** is hot, and somewhat unhealthy to Europeans.

Agriculture is not in a thriving condition, and the manufactures are unimportant. The principal **productions** are; timber, hides, coffee, sugar (not so much as formerly), honey, cocoa, tobacco, fruits.

The **population** is about 800,000, chiefly negroes and mulattoes.

The **government** is nominally Republican, but the island is generally in an unsettled condition. It is at present divided into two republics; **Hayti**, in the west, and **San Domingo** in the east.

Hayti was discovered by Columbus in 1492. It was held by Spain till 1691, when the western part was ceded to France. The latter country ultimately became possessed of the whole island. After many insurrections and sanguinary wars the negroes secured their independence in 1803.

The **CHIEF TOWNS** are; (1) **Port au Prince.** Population 30,000; capital of Hayti. Chief port, situated on a fine bay. (2) **San Domingo,** on the south coast; capital of San Domingo.

II. SOUTH AMERICA.

SITUATION. South America forms the southern portion of the great continent of America. It lies between 12° north and 56° south latitude; and between 35° and 82° west longitude. About two-thirds of its area is situated within the tropics.

BOUNDARIES.

North, the Caribbean Sea.
West, the Pacific Ocean.
South, the Straits of Magellan.
East, the Atlantic Ocean.

EXTENT.

Length, 4,500 m., from Cape Gallinas to Cape Froward.

Breadth, 3,300 m., from Cape St. Roque to Cape Parina. The breadth gradually diminishes towards the south.

Area, 6,500,000 sq. m.

Most northern point: Cape Gallinas.

Most western point: Cape Parina.

Most southern point: Cape Froward. (Cape Horn is on the southern islands.)

Most eastern point: Cape Branco.

COAST. Not much indented. There are no great openings into the land as in the northern portion of the continent, and no large peninsulas. Like Africa, South America is a large unbroken mass of land.

SEAS, BAYS, GULFS.

Gulf of Panama,
Bay of Choco,
Gulf of Guayaquil, } Connected with the Pacific.

Gulf of St. George,
Gulf of Antonio,
False Bay,
Mouth of the La Plata,
Mouth of the Amazon, } Connected with the Atlantic.

Gulf of Maracaybo,
Gulf of Darien, } Connected with the Caribbean Sea.

STRAITS.

Strait of Magellan, situated between the mainland and the island of Tierra del Fuego, and named after the celebrated Portuguese navigator.

Strait of Le Maire, between Tierra del Fuego and Staten Island.

CAPES.

Cape Parina, the most western point.
Cape Froward, the most southern point of the mainland.
Cape Horn, on the small island of the same name.

Cape Corrientes,
Cape St. Antonio,
Cape Frio,
Cape Branco,
Cape St. Roque, } On the east.

Cape Gallinas, in the north.

ISLANDS. Not numerous.

Curaçoa, Margarita, near the north coast.

Trinidad and some of the West India Islands lie near the north coast of South America.

Falkland Islands, east of Patagonia.

The Archipelago of Tierra del Fuego, in the south, containing Tierra del Fuego, Staten Island, and many others.

The Patagonian Archipelago, on the west coast; the largest island is Chiloe.

Juan Fernandez, west of Chili.

Galapagos Islands, west of Ecuador.

SURFACE. The mountain regions lie in the west, north, and east. The centre and south consist of vast plains which occupy about three-fourths of the area of South America.

MOUNTAINS.

The Andes, extending the whole length of South America from north to south. Considered with regard to both length and height, this is the largest range of mountains in the world. It passes through Columbia, Peru, Bolivia, Chili, and Patagonia. In some parts it consists of a double and in others of a triple chain of mountains. In the widest part it is about 400 miles in breadth. It decreases in height and breadth towards the south. Many of its peaks are volcanoes, and the countries it traverses are liable to earthquakes of a fearful kind. The snow-line near the equator is at a height of from 15,000 to 18,000 ft.

The chief summits are *Aconcagua* (in Chili), 24,000 feet, the highest mountain in the New World; *Sorata, Illimani* (both in Bolivia), 22,000 ft.; *Chimborazo* (in Columbia), 21,500 ft.; *Antisana, Cotopaxi* (volcanoes in Columbia), 18,000 ft.

Many elevated plateaux occur among the ranges of this great mountain sytem. The most celebrated is the *Plateau of Quito,* near the equator, at an elevation of 9,000 ft.

Mountains of Guiana, extending from west to east, parallel to the coast. The highest summit is *Maravaca,* 10,000 ft.

Mountains of Brazil, an extensive system, consisting of a number of parallel ranges and table-lands. The ranges run generally north and south, and the valleys between them are traversed by tributaries of the Amazon and by rivers flowing into the Atlantic. The principal chain is the *Sierra do Espinhazo* which attains an elevation of about 6,000 ft.

PLAINS. A great plain stretches through the whole extent of South America, from north to south, bounded on the west by

the Andes, and on the east by the mountains of Brazil. It is divided into three regions.

(1) **The Llanos,** or grassy plains of the north, watered by the River Orinoco. They are destitute of trees, and inundated by the overflowing of the streams during the rainy season. In the dry season they are parched and barren.

(2) **The Selvas,** or forest-plains of the Amazon, covered with trees of majestic size and vegetation of the most luxuriant growth. The rivers are bordered in many parts by immense swamps.

(3) **The Pampas,** watered by the River La Plata. These are level plains of immense size covered with swamps and great tracts of long grass, thistles, and coarse vegetation. A narrow plain stretches along the west coast, between the Andes and the sea. It varies in width from 50 to 150 miles. The most fertile part is Chili.

RIVERS.

(1) FLOWING INTO THE PACIFIC. Owing to the proximity of the Andes to the sea, these rivers are very short and unimportant. Most of them are only mountain streams. The largest is the—

Biobio, in Chili, 150 m. At its mouth is Concepcion.

(2) FLOWING INTO THE ATLANTIC.

Negro, 800 m., rising in the Andes and flowing along the northern boundary of Patagonia into the Atlantic.

Colorado, 600 m., north of the Negro.

La Plata, an estuary formed by the junction of the Parana and Uruguay. The Parana is the larger branch. It rises in the mountains of Brazil and flows south into the estuary of the La Plata. In its course it receives the Paraguay, a tributary as large as itself. The Uruguay has a shorter course and falls into the La Plata farther to the east. The total length of this river system from the source of the Parana to the mouth of the La Plata is 2,500 miles. At its mouth is Buenos Ayres, the capital of the Argentine Republic.

San Francisco, 1,500 m., rising in the Brazilian Mts., and flowing north-east into the Atlantic.

Paranaiba, rising in the Brazilian Mts., and flowing north-east into the Atlantic.

Amazon or **Maranon,** 4,000 m., the largest river in the world. It rises in Peru on a table-land on the eastern slope of the Andes, issuing from the small lake of Lauricocha. It flows north for some distance then turns eastward, forms the boundary between Peru and Columbia, and after traversing Brazil from west to east empties itself by an enormous estuary into the Atlantic Ocean. Its current is felt for several hundred miles out at sea.

It passes through an immense plain, which is covered with trees and other vegetable productions of the most exuberant growth, and which constitutes one of the naturally richest portions of the earth's surface.

Its *tributaries* are of vast size. The largest are ; on the right bank, Ucayali, Madeira, Tapajos, Xingu, Tocantins (which receives the Araguay) ; on the left bank, Yapura, Negro. The Madeira is about 2,000 miles in length, or about as long as the Volga.

The basin of the Amazon has an area of about 2,500,000 sq. m. It is navigable for large vessels to a distance of about 3,000 m. from its mouth.

Essequibo, flowing north through British Guiana into the Atlantic.

Orinoco, 1,200 m., the third largest river of South America. It rises in the Brazilian Mts., and after a semicircular course through Columbia flows into the Atlantic Ocean and Caribbean Sea by many mouths, which form a large delta.

Its chief **tributary** is the Casiquiare, which is connected with the Negro, a tributary of the Amazon.

(3) FLOWING INTO THE CARIBBEAN SEA.

Magdalena, 850 m., rising in the Andes, and flowing north, through Columbia into the Caribbean Sea.

Its chief *tributary* is the Cauca.

LAKES. South America has no lakes of very large size. In this respect it presents a singular contrast to North America. The principal are—

Maracaybo, 5,000 sq. m. This is a lake only in name, since it is connected with the Gulf of Maracaybo by a narrow strait.

Titicaca, 4,000 sq. m. situated on a table-land at the height of more than 12,000 ft., between Peru and Bolivia.

Merim, near the east coast of Uruguay.

CLIMATE. The greater part of South America is situated within the tropics and is consequently very hot. The heat is however moderated by the great elevation of much of the surface near the equator. Thus Quito, situated near the equator, at a height of more than 9,000 feet, enjoys a mild and delightful climate. Much rain falls in most parts during the rainy season, the rest of the year is very dry, and the ground becomes parched. The south is cold and dry.

SOIL. Generally fertile, except in the mountain districts. The great central plain is capable of being brought to a very high degree of cultivation, and will probably one day support many millions of the human race. The south is somewhat dry, cold, and barren.

MINERALS. Rich and abundant. The principal are—

Gold, in Brazil, Peru, Chili, Bolivia.

Silver, in Bolivia, Peru, Chili, La Plata.

Precious Stones, in Brazil (famous for diamonds), Peru, Chili, Columbia.

Copper, in Chili, Peru.

Tin, in Peru.

Lead, in Peru, Bolivia.

Quicksilver, in Peru.

Iron, in Brazil, Columbia, Bolivia.

Coal, in Chili.

Salt, almost everywhere, especially in the plains of La Plata.

ANIMALS. Very abundant, but mostly inferior in type to those of the Old World.

(1) **Wild Beasts.** Puma, jaguar, llama, tapir, sloth, ant-eater, opossum, armadillo, monkey (small, but of great variety), wild horse, wild ox.

(2) **Domestic Animals.** Horse and most other European kinds, introduced by colonists.

(3) **Birds.** Condor, emu, albatross, toucan, parrot, humming-bird.

(4) **Reptiles.** Alligator, boa-constrictor, rattlesnake (and other venomous serpents, in great abundance), turtle, bull-frog.

(5) **Insects.** Very numerous, and often of very brilliant and variegated appearance. Mosquito, gigantic ant, beetle, fire-fly, centipede.

(6) **Fishes.** Mostly the same as in North America, but less abundant.

VEGETATION. The most luxuriant in the world. The mass of tangled vegetation of countless varieties which covers the plain of the Amazon is unparalleled in any other part of the globe. Vast quantities of ferns, cactuses, gorgeous water lilies, thistles, grasses, and other plants.

(1) **Trees.** Palm, gigantic fern, fir, mahogany, banana, cocoa-nut, caoutchouc (indiarubber tree), Peruvian bark.

(2) **Objects of Culture.** Corn, cocoa, potato, tobacco, sugar-cane, banana, rice, and tropical fruits.

POPULATION. About 20,000,000. The following are the principal varieties of race inhabiting South America.

(1) **Europeans,** mostly of Spanish and Portuguese descent, in Brazil, Columbia, Peru, Chili, Bolivia, La Plata.

(2) **Negroes,** in Brazil.

(3) **Patagonians,** in the south. A native Indian race, considered the tallest in the world, the average height being about six feet.

DIVISIONS.

United States of Columbia,	*capital,*	Bogota.
Venezuela,	„	Caracas.
Ecuador,	„	Quito.

Guiana, including—		
British Guiana,	*capital*	Georgetown, on the Demerara.
Dutch Guiana,	„	Paramaribo, on the Surinam.
French Guiana,	„	Cayenne, on the Isle of Cayenne.
Brazil,	„	Rio Janeiro, on the coast.
Peru,	„	Lima.
Bolivia,	„	Chuquisaca.
Chili,	„	Santiago.
Argentine Republic,	„	Buenos Ayres, on the La Plata.
Paraguay,	„	Assuncion.
Uruguay,	„	Monte Video.

Patagonia.

UNITED STATES OF COLUMBIA.

This is a confederate republic consisting of nine states, namely, **Antioquia, Bolivar, Boyaca, Cauca, Cundinamarca, Magdalena, Panama, Santander, Tolimar.** It was formerly named New Granada.

It is **bounded** on the north by the Caribbean Sea, on the west by the Pacific, on the south by Ecuador, and on the east by Venezuela.

Its *area* is about 330,000 sq. m.

A large part of its **surface** is mountainous, and covered by the Andes and its offshoots, but there is much fertile land in the north and east. Its chief **river** is the Magdalena.

Its **climate** is tropical, as it is situated only a short distance north of the equator, but the high lands are mild and agreeable.

The **forests** supply mahogany, cedar, and other kinds of timber.

Its **minerals** are abundant; gold, silver, precious stones, iron, etc.

The chief **objects of culture** are: tobacco, cotton, coffee, corn, cocoa, indigo, sugar-cane.

It has few **manufactures**; the principal are rude woollen and cotton goods for home use.

The **commerce** is somewhat important. A considerable trade is carried on by means of the railway across the Isthmus of Panama (which is included in this republic). The chief *imports* are manufactured goods. The *exports* are indigo, cocoa, coffee, timber, raw cotton, dyewoods, tobacco. Its chief *ports* are Cartagena, Panama, Aspinwall.

The **population** is about 3,000,000.

The **religion** is Roman Catholic, but all are tolerated.

CHIEF TOWNS.

Bogota, or **Santa Fe de Bogota,** on a table-land 9,000 feet high. Capital. Population, about 40,000. Seat of a university. Subject to earthquakes.

Carthagena, one of the chief ports. Situated on a fine bay in the Caribbean Sea.

Panama, on the Pacific side of the Isthmus. A railroad runs from Panama to Aspinwall in the Caribbean Sea.

Portobello, a small port in the Isthmus of Panama.

Popayan, an inland town in the south.

VENEZUELA.

This is a republic lying to the east of Columbia.

It is bounded on the *north* by the Caribbean Sea, on the *west* by the United States of Columbia, on the *south* by Brazil, and on the east by the Atlantic and British Guiana.

Its *area* is about 420,000 sq. m.

The **surface** is mountainous in the west, where the Andes traverse the country; the eastern portion is flat and occupied by the Llanos, or grassy plains of the Orinoco.

The **climate** resembles that of Columbia.

The **forests** supply timber of the same kinds as Columbia.

The chief **objects of culture** are: cocoa, coffee, tobacco, maize, sugar-cane, cotton. Great numbers of cattle are reared.

The **commerce** is unimportant. Its chief *imports* are: manu-

factured goods, provisions, wine. Its chief *exports* are: cocoa, sugar, coffee, tobacco, dye-woods, timber, hides, cotton. Its chief *port* is La Guayra, on the Caribbean Sea.

The **population** is about 1,800,000.

The **religion** is Roman Catholic.

CHIEF TOWNS.

Caraccas, near the Caribbean Sea. Population, about 50,000. Subject to earthquakes.

La Guayra, port of Caraccas.

Cumana. A small port on the coast.

Maraycabo, a port on the Gulf of Venezuela.

Valencia, an inland town with considerable trade.

ECUADOR.

This is a republic lying to the south of Columbia. The equator passes through it; hence its name.

It is bounded on the *north* by the United States of Columbia, on the *west* by the Pacific, on the *south* by Peru, and on the *east* by Brazil.

Its *area* is about 250,000 sq. m.

Its **surface** is mountainous in the west, where it is crossed by the Andes. Some of the highest summits are in this country. It is watered by tributaries of the Amazon which divides it from Peru.

Its **climate** is very hot in the plains, but temperate in the elevated regions.

Its mineral and vegetable **productions** are similar to those of the Columbian States.

Its **exports** are also similar to those of the Columbian States.

The **population** is about 1,300,000.

The **religion** is Roman Catholic.

CHIEF TOWNS.

Quito, population 75,000. Capital. Situated on a table-land more than 9,000 ft. high. Though it is very nearly on the line of the equator, it enjoys a mild and delightful climate;

Guayaquil, the chief port, on the gulf of the same name.
Riobamba, Loxa, Cuença.
The Galapagos Islands, lying to the west in the Pacific, belong to Ecuador.

GUIANA.

(1) BRITISH GUIANA.

(*See* Colonies.)

(2) DUTCH GUIANA, OR SURINAM.

Dutch Guiana lies between British Guiana and French Guiana.
Area, about 60,000 sq. m.
The **coast** is low, and there is much fertile land. The south is hilly. It is divided from French Guiana by the river Maroni, and from British Guiana by the river Corentyn.
It lies within the tropics; the **climate** is hot, humid near the coast, and unhealthy.
There are extensive **forests,** producing timber.
The chief **productions** are sugar, rum, coffee, cotton, timber, rice, cocoa, tropical fruits.
The **population** is about 70,000, most of whom are negroes and Indians.
The **government** is in the hands of a governor-general appointed by Holland.
CHIEF TOWN.
Paramaribo, population 20,000. Capital. On the River Surinam. A regularly built town in the Dutch style, with considerable trade.

(3) FRENCH GUIANA.

French Guiana lies to the east of Dutch Guiana. It is separated from Brazil by the river Oyapok.
Area, about 50,000 sq. m.
The **coast** is low. The south is more hilly. There is much fertile land.
The **climate** and **productions** are similar to those of British

and Dutch Guiana. Pepper and spices are grown in large quantities.

The **population** is about 30,000, chiefly negroes and Indians.

The **government** is in the hands of a French governor. This colony has long been used as a penal settlement.

CHIEF TOWN.

Cayenne, on the Island of Cayenne. Population 5,000. Capital of French Guiana. Chief port, with considerable trade.

BRAZIL.

BOUNDARIES.

North, Guiana, Venezuela, Columbia.

West, Ecuador, Peru, Bolivia.

South, Paraguay, Argentine Republic, Uruguay.

East, the Atlantic.

EXTENT.

Length, 2,500 m. *Breadth,* 2,400 m.

Area, 3,000,000 sq. m.

Thus Brazil comprises nearly half of the entire surface of South America.

COAST. About 3,700 m. The largest opening into the land is the mouth of the Amazon. (*See* General Description of South America.)

SURFACE. The greater part of the surface of Brazil is covered by the **Mountains of Brazil,** and by the **Selvas** or forest-plains of the Amazon. The rivers have already been described. (*See* General Description of South America.) The distinguishing physical characteristics of Brazil are its immense rivers, plains, and forests, its great central table-land, and its luxuriant vegetation.

CLIMATE. Generally healthy and agreeable, very hot in the low lands near the equator, but mild on the table-lands. It has some unhealthy parts near the swamps on the banks of the great rivers.

NATURAL PRODUCTIONS. The forests abound with **wild beasts, birds,** and **reptiles** of the kinds mentioned in the general description of South America. Tropical **trees** and **plants** grow with the utmost vigour and attain to enormous dimensions. Splendid timber is obtained from the vast forests. **Tropical fruits** are produced in the greatest abundance.

Brazil is very rich in **minerals.** Gold, silver, diamonds, and other precious stones, iron, etc.

AGRICULTURE. This is the chief occupation of the people, but it is unimportant compared with the vast size and immense capabilities of the country. Only a small part of Brazil has yet been brought under cultivation. The chief **objects of culture** are sugar, coffee, maize, wheat, manioc, tobacco, rice, cotton, cocoa, ginger. The **domestic animals** are the horse, horned cattle, hog. Slave labour is largely employed in the cultivation of the ground.

MANUFACTURES. Unimportant. A few rude manufactures of **cotton** and **woollen goods** are carried on for domestic use.

The chief **occupations of the people** are agriculture and commerce.

COMMERCE. Important and increasing.

Imports. Manufactured goods, chiefly from England.

Exports. Coffee, cotton, sugar, hides, timber, gold, diamonds, drugs, gums, cocoa, indiarubber, tropical fruits.

Ports. Rio Janeiro, Bahia, Pernambuco, Maranham.

The commerce is carried on chiefly with England and the United States.

INTERNAL COMMUNICATION. Improving. The Amazon forms a magnificent natural means of intercommunication which will one day be of vast utility to Brazil, but at present it is little employed for this purpose. **Railroads** are being made in the settled districts.

POPULATION. 10,000,000. About 1,500,000 are **slaves,**

and 500,000 are **Indians.** The remainder are of **Portuguese, Spanish,** and mixed descent.

RELIGION. Roman Catholic.

GOVERNMENT. A limited monarchy, under an Emperor. There are two legislative assemblies; the Senate, appointed by the Emperor, and a Chamber of Deputies, elected by the people.

Brazil was subject to Portugal till 1825, when it became an independent state.

DIVISIONS. Into 20 provinces. Only th eastern divisions are settled. The vast plains of the interior are either uninhabited or roamed over by virtually independent Indian tribes.

TOWNS. The only large towns are near the coast.

Rio Janeiro, on the east coast, at the western side of a beautiful bay, which forms one of the finest harbours in the world. Population, 275,000. Capital of Brazil. Chief port, with great foreign trade. Largest city in South America.

Bahia, or **San Salvador,** on All Saints' Bay. North of Rio Janeiro. Population, 180,000. Second city and port of Brazil.

Pernambuco, on the east coast, north of Bahia. Population, 70,000. Third city and port of Brazil.

Maranhao, a considerable port situated on an island at the mouth of the River Maranhao.

Para, a port at the mouth of the River Para, the southern branch of the estuary of the Amazon.

San Paulo, a considerable town south of Rio Janeiro. Its port is Santos.

Villa Ricca, Villa Bella, two small towns in the interior of Brazil.

PERU.

BOUNDARIES, and EXTENT.

North, Ecuador.
South, Bolivia.
East, Brazil.
West, the Pacific.
Area, 500,000 sq. m.

COAST. Unindented.

SURFACE. The western portion is very mountainous, being occupied by one of the widest and highest parts of the Andes. The River Amazon forms the northern boundary. The **chief river** is the Ucayali, a tributary of the Amazon.

CLIMATE. Very dry near the west coast. Hot in the valleys, and mild in the elevated regions.

NATURAL PRODUCTIONS. The **forests** produce excellent timber, but it is not much used, owing to the difficulty of transit. The **minerals** are rich and abundant; gold, silver, precious stones, copper, tin, lead, quicksilver. **Guano**, a kind of manure deposited by sea birds, is found in great abundance on the small islands off the coast, especially on the Cincha Islands south of Callao.

AGRICULTURE. Carried on to a moderate extent in the valleys. The **objects of culture** are cotton, sugar, tobacco, corn, cocoa, indigo. There are few **domestic animals.** Sheep are reared to some extent.

MANUFACTURES. Coarse **cotton and woollen goods** are made for home purposes, and there is some working of metals. **Mining** is one of the chief occupations of the people.

COMMERCE. Important, and increasing.

Imports. Manufactured goods.

Exports. Guano, silver, sugar, wool, nitrate of soda, gums, copper, cinchona (Peruvian bark).

Ports. Callao, Arica, Truxillo.

The commerce is chiefly with England and the United States.

POPULATION. About 3,370,000, a large number of whom are Indians.

RELIGION. Roman Catholic.

GOVERNMENT. A republic, with President, and Congress consisting of two Houses.

Peru was subject to Spain till 1822, when it became an independent State.

TOWNS.

Lima. Population, 150,000. Capital of Peru. Situated on the small river Rimac, about 6 miles from the coast. Houses built low, on account of the frequency of earthquakes. Fine cathedral with remains of Pizarro, the famous Spanish warrior.

Callao, port of Lima, with great trade.

Cuzco, in the interior, south-east of Lima. Population, 40,000. Former capital of the Incas, or native rulers of Peru. This city is built on a table-land about 12,000 ft. above the sea.

Arequipa, in the south. Population, 30,000. Subject to earthquakes.

Arica, a seaport in the south.

Truxillo, a seaport in the north.

Huamanco, a considerable town in the interior.

Puno, a town on the western shore of Lake Titicaca.

Pasco, on a table-land nearly 14,000 ft. high.

BOLIVIA, OR UPPER PERU.

BOUNDARIES and **EXTENT.**

North, Brazil, Peru.

West, Peru, Pacific Ocean.

South, Chili, Argentine Republic.

East, Brazil.

Area, 500,000 sq. m.

SURFACE. The west is mountainous, being occupied by the broadest and loftiest part of the Andes, here called the East and West Cordilleras. The eastern part of this great mountain chain slopes down into terraces and valleys covered with immense forests and watered by numerous streams, mostly tributaries of the Madeira, which flows into the Amazon.

CLIMATE. Similar to that of Peru.

NATURAL PRODUCTIONS. Vast numbers of wild beasts, birds, and reptiles are found in the forests. Trees and plants of endless varieties and enormous growth cover the mountain slopes and the valleys. Gold, silver, lead, iron, and other

minerals are found in great abundance. The silver mines of Potosi are very famous.

AGRICULTURE. Improving. The chief **objects of culture** are rice, cocoa, coffee, cotton, tobacco, maize, sugar-cane, indigo. The **domestic animals** are the horse and other European varieties, and the llama and alpaca.

MANUFACTURES. Unimportant. **Cotton and woollen goods** of a coarse kind, leather.

COMMERCE. Unimportant. The mountains cut off the greater portion of Bolivia from the sea, and the coast line is very short and inconveniently situated. The produce of the country is mostly carried through Peru. Bolivia only possesses one small port, Cobija.

The **exports** are metals, hides, bark, wool, guano.

POPULATION. 2,000,000, mostly Indians, or mixed races.

RELIGION. Roman Catholic.

GOVERNMENT. A republic, under a President and Legislative Assembly.

Bolivia was formerly subject to Spain. It became a republic in 1825, being named after Simon Bolivar, the general under whom it achieved its independence.

DIVISIONS. Nine departments.

TOWNS.

Chuquisaca, in the interior. Population, 20,000. Capital of Bolivia.

La Paz, population, 40,000. Near Lake Titicaca. The largest city of Bolivia, with considerable trade.

Cochabamba, in the interior. Population, 30,000.

Potosi, in the interior; situated on the side of Mount Potosi, at a height of 13,000 feet above the sea. Celebrated for its great silver mines, which are now much less productive than formerly.

Cobija, the only port of Bolivia. Its trade is small.

CHILI.

BOUNDARIES and EXTENT.

Chili is a narrow strip of land situated between the Andes on the east and the Pacific on the west. It extends from Bolivia in the north to Patagonia in the south.

Its *area* is about 125,000 sq. m.

Its coast line extends about 1,200 m.

To the south lies the large island of Chiloe.

The island of **Juan Fernandez**, in the Pacific, belongs to Chili.

SURFACE. Mountainous; occupied chiefly by the Andes and its offshoots. The mountains decrease in height from north to south. Many of the valleys are fertile.

The **rivers** are short. The longest is the Biobo. Further north is the Maypu.

CLIMATE. Temperate and healthy. Much rain falls in the rainy season, from June to September. Chili is subject to **earthquakes.**

NATURAL PRODUCTIONS. Much of the land is covered with **forests**, which contain trees, plants, and animals of South American varieties.

The **minerals** are gold, silver, precious stones, copper, coal. **Mining** is the chief occupation of the people.

AGRICULTURE. Of considerable importance. The chief **objects of culture** are maize, wheat, barley, hemp, flax, potato. Cattle rearing is carried on to a great extent.

MANUFACTURES. Of a rude kind. Earthenware, hempen cloths, cordage, wine, hardware.

COMMERCE. Important and increasing.

Imports. Manufactured goods, chiefly from England.

Exports. Copper, silver, gold, corn, hides, guano, wool, tallow.

Ports. Valparaiso, Coquimbo, Valdivia.

POPULATION. 2,000,000, chiefly of Spanish and mixed descent.

RELIGION. Roman Catholic.

GOVERNMENT. A republic, under a President, a Senate, and a House of Representatives.

Chili was subject to Spain till 1817, when it became independent.

DIVISIONS. Sixteen provinces.

TOWNS.

Santiago, population 180,000. Capital of Chili. Situated on a tributary of the Maypu. It is a large, fine city, with considerable trade.

Valparaiso, population 70,000. Chief port, connected with the capital by railway. Destroyed by earthquake in 1822.

Concepcion, a port at the mouth of the River Biobo. Several times destroyed by earthquake.

Coquimbo, Copiapo, ports in the north of Chili.

San Carlos, the chief town of the island of Chiloe.

ARGENTINE REPUBLIC, OR LA PLATA.

BOUNDARIES and EXTENT.

North, Bolivia and Paraguay.

West, Bolivia and Chili.

South, Patagonia.

East, the Pacific, Uruguay, Brazil, Paraguay.

Area, 850,000 sq. m.

COAST. Not extensive, extending along the Pacific, from the estuary of the La Plata to the River Negro. The largest openings are the estuary of the La Plata and False Bay.

SURFACE. Mostly flat. This portion of South America consists chiefly of an immense level tract watered by the tributaries of the La Plata. Vast treeless plains called **Pampas** extend over the surface of the country. (*See* General Description of South America.) There are several barren wastes, as

the sandy desert called **La Salinas**, in the centre; **El Gran Chaco**, a sterile region in the north-east, and the salt swamps in the south-east. The country is watered by the Parana and its tributaries. In the south are the Rivers Colorado and Negro.

CLIMATE. Hot in the north; cooler in the south. Very dry and very wet during the dry and rainy seasons respectively.

NATURAL PRODUCTIONS. This region is not so rich in vegetable productions as the northern parts of South America. **Forests** are less numerous and extensive. The chief **minerals** are silver, copper, and salt.

AGRICULTURE. Improving. Only a small portion of this vast territory has yet been brought under cultivation. The chief **objects of culture** are wheat, maize, rice, cotton, indigo, tobacco, fruits. Immense herds of **cattle** are reared on the Pampas. Horses and sheep are very numerous.

MANUFACTURES. Few and unimportant, chiefly coarse woollen goods.

COMMERCE. Important and increasing. Many European colonists settle in this part of South America, especially emigrants from Italy.

Trade has been greatly facilitated by the formation of railways.

Imports. Manufactured goods.

Exports. Hides, wool, horns, tallow, meat, furs.

Ports. Buenos Ayres, Rosario.

POPULATION. Nearly 2,000,000.

RELIGION. Roman Catholic.

GOVERNMENT. A federal republic, each State being independent in the management of its internal affairs.

This country was subject to Spain till 1816, when it became independent. The Federal Republic was formed in 1819.

DIVISIONS. The Confederation includes 14 independent States. The largest is Buenos Ayres.

TOWNS.

Buenos Ayres, on the La Plata. Population. 180,000. Capital of the Argentine Republic. Chief port, with great trade. A large and well-built town, with a fine cathedral.

Cordova, population 20,000. A considerable town in the interior.

Corrientes, on the Parana.

Parana, on the Parana, former capital.

Mendoza, near the Andes.

Santiago, on the River Dolce.

Carmen, on the River Negro.

PARAGUAY.

This is a small republic in the interior of South America.

It lies between the rivers Paraguay and Parana, and has an *area* of about 60,000 sq. m.

It has no **coast**; its surface is generally flat.

Its **climate** is mild and healthy.

Its **forests** produce valuable timber.

The **objects of culture** are maize, rice, tobacco, indigo, sugar, cotton, Paraguay tea.

Its **manufactures** and **trade** are very small.

Its **population** is about 300,000. Before the war with Brazil and the Argentine Republic, its population was much larger.

Its **government** is a republic; **religion,** Roman Catholic.

It was subject to Spain till 1811, when it became independent.

CHIEF TOWNS.

Asuncion, on the Paraguay. Population, 15,000. Capital of Paraguay.

Villa Real, in the interior

URUGUAY, OR BANDA ORIENTAL.

This is a republic on the east coast of South America, between Brazil and the estuary of the La Plata.

Its *area* is about 70,000 sq. m.

The **surface** is generally flat. It is watered by the River Negro and other tributaries of the Uruguay, which forms its western boundary.

Its **climate** is similar to that of the Argentine States.

It **produces** wheat, maize, cotton. Vast numbers of cattle, sheep, and horses are reared on its plains.

The **imports** are chiefly manufactured goods.

The **exports** are hides, wool, tallow, horns, preserved meat.

The **population** is about 500,000.

The **government** is a republic; **religion**, Roman Catholic. It was a province of Brazil till 1825, when it became independent.

CHIEF TOWNS.

Monte Video, on the La Plata. Population, 10,000. Capital and chief port.

Colonia and **Maldonado**, small ports on the La Plata.

PATAGONIA.

This is an unsettled territory lying at the extreme south of America.

Its *area* is about 350,000 sq. m.

Its **coast** is irregular, especially on the west, and broken up into numerous bays, capes, peninsulas, and islands. On the west is the peninsula of Tres Montes. At the south is the large island of Tierra del Fuego.

The **surface** is generally flat, but the Andes extend along the west coast. The soil is generally stony and barren.

The **climate** is dry, and cold in the south.

The plains abound in **wild animals**, as wolves, ostriches, pumas, wild horses, and wild cattle. Whale and seal fishing is carried on near the coasts.

The **population** is unknown. The Patagonians are an uncivilized race, very tall and strong, living by hunting and fishing, and leading an unsettled life.

The eastern part of Patagonia is claimed by the Argentine Confederation, and the western by Chili. These claims are, however, only nominal; there is no settled government. Each tribe is independent of the others. **The Fuegians**, a tribe found on the west coast, are of low stature and apparently a race distinct from the others.

There are no towns.

THE OCEANS.

I. GENERAL CHARACTERISTICS.

The Ocean is a general name given to a vast mass of water which surrounds the earth and occupies the greater part of its surface. All the water in the world is connected directly or indirectly with the ocean. Thus the inland seas are directly connected with the ocean by means of straits. Bays, gulfs, and other indentations of the coast are either connected directly with the ocean or indirectly by the seas to which they belong. Rivers obtain their water by evaporation from the ocean and seas, and flow down to the seas and ocean from which their water arose. Similarly the streams which flow into rivers, lakes, and even ponds, are fed by water from the ocean.

The ocean is the largest object with which we are acquainted in this world. As it surrounds the world and partakes of the rotundity of the globe on which we live, it has neither beginning nor end, and so has always been regarded as an "Emblem of Eternity."

The ocean is the great highway of commerce. It appears at first sight to separate countries from each other, but in reality it brings them together. The ocean is a broad, open path formed by nature and free to all, on which numberless vessels of all nations sail to and fro night and day, carrying passengers and goods of every description.

The ocean is one of the most important agents which determine and modify the climate of different parts of the world. The fish and other marine animals it contains form one of the

principal sources from which the food of man is obtained. One of the most useful articles employed in our daily life, salt, is obtained from its water in inexhaustible abundance.

As a magnificent spectacle, the ocean cannot be surpassed. The sea on a calm day, as seen from the land, with its gentle waves sparkling in the sunlight and breaking in white foam on the sand, is one of the most beautiful objects in nature. Then, again, when its waters are lashed by the winds, and its waves roll "mountains high," dashing in huge billows against the rocks, and tossing the mighty ships like toys on its surface, no one can behold it unmoved or fail to be struck with the sublimity of the scene. The aspect of the ocean, whether regarded in reference to its boundless extent and variety, or to its grandeur, majesty, power, and sublimity, fills the mind with awe, and lifts the soul up to the Creator of all things.

EXTENT AND DISTRIBUTION. We have already seen that all the water in the world is connected with the ocean. The surface of the earth is made up of land and water. Since the diameter of the earth is nearly 8,000 miles (7,916 miles), its convex surface is about 200,000,000 square miles. (*See* Mensuration.) About 52,000,000 square miles of this surface consist of land, and 148,000,000 square miles of water. Hence the surface composed of water is nearly three times as large as that composed of land. In other words, rather more than one-fourth of the surface of the earth is land, and nearly three-fourths is water.

In the southern hemisphere (that south of the equator) the water vastly predominates over the land. The largest masses of land are all in the northern hemisphere.

Again, if we make the neighbourhood of New Zealand the centre of a hemisphere, we shall find that it is almost entirely composed of water. The land of the globe nearly all lies in the opposite hemisphere. Thus the world may be divided into two hemispheres: that of water, of which New Zealand is the centre, and that of land, with Great Britain in the centre.

Hence it will be seen that the British Islands are placed in a most advantageous situation with respect to commerce.

COLOUR. The colour of the sea varies according to circumstances. It is affected by the weather, especially near the coasts. It is sometimes modified by the character of the rocks or soil which it covers, or to which it is adjacent. Sometimes the presence of countless multitudes of animalculæ impart their own hue to the water. Seaweed also affects the appearance of the surface of the sea. The colour generally attributed to the ocean is blue, or deep bluish green. On a fine day, and when viewed from the coast, the sea often appears of a very deep blue. The poets are fond of speaking of the colour of the ocean, as in the following passages :—

"Roll on, thou deep and dark blue ocean, roll."—*Byron.*

"The sea, the blue lone sea, hath one."—*Mrs. Hemans.*

Some parts of the sea are so called from the colour of the water. Thus we have the Black Sea, the White Sea, the Yellow Sea, the Red Sea, etc. The water of the ocean sometimes appears luminous or phosphorescent at night, especially in the track left by the passage of a vessel, for a few moments in the water.

The colour of the ocean is only observable when viewed in large masses. If a quantity of it be taken up in a vessel, it appears colourless, like fresh water. Sometimes the apparent colour is only an optical effect, or it is merely borrowed from various substances contained in the water.

SALTNESS. The water of the sea is salt and bitter, owing to its composition. It is a mixture of water, common salt (muriate of soda), magnesia, and other substances. Sea water is rendered unfit for drinking purposes by the presence of these various ingredients, though it can be made fresh by evaporation. Salt is obtained in large quantities from the sea by setting free the water by boiling.

There are various opinions as to the cause of the saltness of

the sea. It is generally supposed that it is owing to the existence of large salt-beds beneath the water of the ocean, but this subject has not yet been sufficiently investigated to admit of any certain theory being formed.

The presence of salt in the ocean is part of the wise arrangements of nature; the water is kept from becoming corrupt, and it is also prevented from freezing except in very high latitudes. The main highways of commerce are never frozen over; ships traverse the Pacific and Atlantic Oceans in all seasons of the year, and it is only in the Arctic and Antarctic regions that navigation is impeded by ice. Besides these advantages, the water of the sea is a vast reservoir from which salt of the purest kind is obtained in large quantities.

The degree of saltness varies in different localities on account of various circumstances. The sea is less salt near the mouths of great rivers, owing to the volume of fresh water poured into it; and also near the poles, on account of the melting of the icebergs. In tropical regions immense quantities of fresh water are drawn off by evaporation, leaving the relative amount of salt remaining in the sea greater than at the poles. The various parts of the sea differ in this respect. The Baltic and Black Seas fall below, the Mediterranean rises above the average degree of saltness. Some inland seas (or rather lakes) are salt to an extraordinary degree. Thus the water of the Dead Sea is about eleven times as salt as that of the ocean. The Caspian Sea is not quite so salt as the ocean.

TEMPERATURE. The temperature of the sea is more uniform than that of the land. Water is a bad conductor of heat; hence it receives heat less readily and parts with it more slowly than the land. During the day the sea is colder than the land, while during the night it is warmer. The sea has a great influence on climate. It is found that countries bordering on the sea are greatly influenced by the sea breezes which blow over them, and that they have a more uniform temperature than inland regions. The sea, like the land, is of course colder

in higher than in lower latitudes. Near the poles the water of the ocean is constantly frozen, notwithstanding its saltness.

The water near the surface of the ocean is greatly influenced by the latitude of the place, but below a depth of about 500 fathoms, the temperature is much more uniform. At that depth the temperature is usually from about 40° to 45°. Beneath that depth the temperature gradually diminishes till it sinks to about the freezing point of water, or somewhat above 30°. The waters of the Gulf Stream increase the temperature of the North Atlantic Ocean.

DEPTH. Various observations have been made from time to time with regard to the depth of the ocean, by means of sounding apparatus. A heavy weight is let down to the bottom of the water by a line, and by means of an ingenious contrivance called a dredge, some of the soil forming the bed of the ocean can be brought up for inspection. Specimens of the animal and vegetable life beneath the sea are obtained in the same manner. Much information of this kind was obtained by scientific men who took observations on board H.M.S. *Challenger*.

The **bed of the ocean** resembles in many respects the surface of the land. In some parts it sinks into deep valleys; in others it forms immense plains, or table-lands. High rocks and mountains rise abruptly from the depths beneath, forming islands when they appear above the surface. Near the land the bottom of the sea often corresponds with the character of the coast; when the latter is low and flat the water is generally shallow for a considerable distance, and, on the other hand, when the coast is bold and rocky the sea frequently sinks down abruptly to a great depth.

The greatest depths of the ocean are supposed to exceed in some degree the altitude of the highest points of the land. The greatest known depth is said to have been found by American observers off the coast of Japan, where they made a sounding of about 30,000 feet, or about 1,000 feet more than the elevation of the highest mountain in the world. The greatest depth obtained by the *Challenger* was about 27,000 feet. Captain James

Ross found a depth of more than 27,000 feet near St. Helena. Still greater depths are reported to have been discovered, but are not to be relied on.

Near to the land the sea generally is less deep than in mid-ocean. The Straits of Dover are scarcely 200 feet deep in the deepest part. The North Sea attains to a depth of 400 feet. The greatest depths in the Mediterranean are about 6,000 feet. The Black Sea soundings give about 3,000 feet for the deepest part.

The **pressure** of the water at the bottom of the ocean is immense. It may be calculated by taking the weight of a cubic foot of water at sixty-two pounds. Living creatures at the bottom of the sea could not sustain this pressure were it not that (by a law of hydrostatics) it acts in every direction, so that the force of a liquid on one side of a body is balanced by an equal one on the other side.

Various marine animals, shells, sand, clay, chalk, and other substances have been brought up from the bed of the ocean. Vegetable life exists only near the surface. Beyond a depth of 1,200 feet the rays of the sun do not penetrate. It is probable therefore that perpetual darkness reigns in the lowest waters of the sea, except where phosphorescent animals shed an uncertain light.

WAVES. The sea is in perpetual motion. This continual movement, together with its saltness, keeps it pure. There are three kinds of movement visible in the waters of the ocean; namely, (1) waves, (2) currents, (3) tides.

Waves are temporary movements of the surface of the water when agitated by the wind or any similar disturbing influence. Waves are generally produced by the wind, but they are sometimes occasioned by other agencies acting on a smaller scale, as the passage of a vessel through the water, the falling of an iceberg or other body into the sea, etc. Sometimes the wind only causes a gentle ripple on the surface; at other times, when a tempest is raging, the waves rise to such an extent that huge ships are wrecked by the violence of the motion.

Waves do not disturb the waters of the sea to a great depth. Even in a great storm, all is tranquil beyond the depth of about three or four hundred feet.

Waves rise to a greater or less height according to the strength of the disturbing causes. In very violent tempests they have been observed to attain a height of between thirty and forty feet.

Waves dash with great violence against the rocks and the shore. The rugged appearance of a rocky coast is caused by the force of the waves, which have washed away masses of earth and stones. Countless millions of pebbles worn round and smooth by the ceaseless action of the waves, and vast tracts of the finest sand produced by the same restless agency, line the low parts of the coast. Sometimes the sea makes inroads on the land by washing away a portion of the coast. On the east coast of England, for example, villages which were once situated two or three miles inland are now found close to the sea.

(For **Currents** and **Winds** see Year III.).

II. DIVISIONS OF THE OCEAN.

There is properly but one great ocean, since what are often called the five oceans really constitute one great and undivided body of water which extends all round the globe. It has, however, been found convenient to give separate names to different parts of this vast mass of water, and the classification which has been adopted agrees to some extent with the natural distribution of land and water on the surface of the earth. The

following are the names of the five great divisions of the water :—

Atlantic Ocean,	area about	25,000,000	square miles.
Pacific Ocean,	„	90,000,000	„
Indian Ocean,	„	20,000,000	„
Arctic Ocean,	„	3,000,000	„
Antarctic Ocean,	„	3,000,000	„

These and other measurements of the oceans can only be taken as vague approximations, since the boundaries of each are very indefinite.

THE ATLANTIC OCEAN.

This is the best known and most frequented of all the great oceans. It forms the great highway between the nations of Europe and the Republics of America. It is traversed by the great ocean steamers which ply between Great Britain and the United States and the British colonies in America, Australia, South Africa, and New Zealand. The electric cables which convey messages with the speed of lightning between Europe and America lie buried beneath its waters.

Its name is derived from the Atlas Mountains, in North Africa. It was first crossed by Christopher Columbus in his memorable voyage in 1492.

BOUNDARIES.

North, the Arctic Ocean.
East, Europe and Africa.
South, the Antarctic Ocean.
West, America.

EXTENT.

Length, about 9,000 miles.

Breadth, varying from about 930 to 4,200 miles.

Length of Coast, about 48,000 miles (including the inland seas).

GENERAL DESCRIPTION. The Atlantic Ocean has the form of an immense trough or canal, extending from the Arctic to the Antarctic Ocean.

It is distinguished by the number and extent of the inland seas which are connected with it. (*See* below.) In this respect it offers a strong contrast to the Pacific. Hence the Atlantic has been said to be the most *maritime* and the Pacific the most *oceanic* of all the great oceans.

The sides of the Atlantic are generally parallel to each other. The convex parts of the western shore correspond with the concave portions of the eastern shore. Thus the projecting portion of South America terminated near Cape St. Roque fits into the great bend of the African coast called the Gulf of Guinea, while the vast convexity of North Africa answers to the immense hollow in the American continent represented by the Caribbean Sea and the Gulf of Mexico.

The Atlantic is also distinguished by the number and great size of the rivers which flow into it and the seas connected with it. Thus we have the Amazon, the Mississippi, the La Plata, the St. Lawrence, the Orinoco, the Danube, the Nile, the Niger, the Rhine, etc., each of which drains an immense basin. The extent of country thus drained by the streams flowing into this ocean far exceeds in area that drained by those falling into the Pacific, though the size of the latter is so much greater. The sides of the Atlantic are sloping, the great watersheds of the continents are greatly removed from it, and therefore the rivers which flow into it have a long course. On the other hand, the land boundaries of the Pacific are generally steep and precipitous, the great watersheds of the continents approach it more

nearly, and therefore the rivers which flow into it are short. The great watershed of North and South America, for example, consisting mainly of the Rocky Mountains and the Andes, is much farther from the east than from the west coast. Consequently the rivers flowing into the Atlantic are much longer than those flowing into the Pacific Ocean.

This ocean is divided by the equator into the **North Atlantic** and **South Atlantic** Oceans.

The average **depth** is supposed to be about 15,000 feet. Near the eastern and western shores the depth is not great, but towards the centre this ocean sinks to depths of over 20,000 feet. Off the west coast of Ireland the Atlantic suddenly sinks from a depth of only a few hundred to more than 2,000 feet. Between Cape Clear, in Ireland, and Cape Race, in Ireland, there stretches a remarkable ridge commonly called the **Telegraphic Plateau**, because the Atlantic cables rest on it.

The **temperature** of the Atlantic is of course dependent chiefly on the latitude. The extreme north is said to be colder than the extreme south. In the North Atlantic navigation is often impeded by **icebergs**, which have been known to descend as far as 40° N.

A remarkable feature of the Atlantic is the **Sargasso Sea**, lying off the north-west coast of Africa between 15° and 30° north latitude. It is situated between the Gulf Stream and the Equatorial Current, and has the appearance of a kind of oceanic pool, covered with seaweed and drift-wood driven into it by the great Atlantic currents.

SEAS and **OPENINGS.** As already remarked, the Atlantic is distinguished for the number and size of the inland seas connected with it. The following are the principal :—

I. ON THE EAST.

(1) **The North Sea**, between Great Britain on the west and

Norway and Denmark on the east. It is sometimes called the German Ocean. It is connected with the English Channel by the Straits of Dover, and with the Baltic by the Skager Rack, the Cattegat, etc. Its *length* is about 600 miles; *breadth*, from 100 to 400 miles; *area*, about 200,000 square miles. Its greatest **depth** is about 600 feet. Its navigation is dangerous, on account of the strong tides, the variable winds, and the numerous sand-banks which it contains. Among these may be mentioned the **Dogger Bank**, stretching across the sea from west to east, and the **Goodwin Sands**, off the coast of Kent. The latter have been particularly fatal to ships. Extensive **fisheries** are carried on, especially near the coasts. This sea has been famous in modern history for the exploits of the maritime races inhabiting the surrounding countries. The Scandinavian sea-kings, or **Vikings**, of Norway and Sweden, the **Angles**, of Denmark, the **Saxons**, of North Germany, the **Jutes**, of Jutland, the **Normans**, of Normandy, are all famous in English history. The chief **ports** connected with the North Sea are:—London, Yarmouth, Hull, Sunderland, Newcastle (in England); Leith, Dundee, Aberdeen (in Scotland); Ostend, Antwerp (in Belgium); Rotterdam, Amsterdam (in Holland); Bremen, Hamburg (in Germany); Christiansand, Bergen (in Norway). The North Sea is singularly destitute of **islands**. The principal are Heligoland and the small islands off the coast of Holland and Schleswig.

(2) **The Baltic Sea**, or **East Sea**, between Sweden on the west and Russia on the east. The northern portion is called the Gulf of Bothnia. Two large openings on the east are called the Gulfs of Finland and Riga. It is connected with the North Sea by the Skager Rack, the Sound, and the Cattegat. Its *length* is about 900 miles; *breadth*, from 40 to 200 miles; *area*, about 90,000 square miles. It is very shallow, its **depth** being only about from 200 to 300 feet. Many **rivers** flow into it, causing its water to be less salt than that of the ocean. Owing to its great distance from the Atlantic, the **tides** are less powerful in the Baltic than in the North Sea. It contains numerous **islands**. The chief **ports** connected with the Baltic

are :—Petersburg, Riga (in Russia) ; Königsberg, Dantzic (in Prussia) ; Lubeck (in Germany) ; Copenhagen (in Denmark) ; Carlscrona, Stockholm (in Sweden).

(3) **The Mediterranean Sea**, between Europe on the north and Africa on the south, the most famous sea in the world. Most of the great empires of the ancient world were situated on its shores. It receives its name from its inland position (Lat. *medius*, middle ; *terra*, the earth). It is connected with the Atlantic Ocean by the Straits of Gibraltar, which are about 11 miles in width. Its *length* is about 2,500 miles ; greatest *breadth*, about 800 miles ; *area*, about 730,000 square miles. The eastern portion of this sea is called the **Levant**. It contains numerous **openings** into the land, of which the principal are :—Gulf of Lyons, Gulf of Genoa, Gulf of Venice, Archipelago, Gulf of Sidra. Its greatest **depth** is about 6,000 feet. A current sets into it from the Atlantic, which is counterbalanced by an undercurrent from the Mediterranean. The **tides** rise only two or three feet. Several important **rivers** flow into it from the countries of Europe and Africa. It contains numerous **islands**, of which the most important are :—Sicily, Sardinia, Corsica, the Balearic Islands, Candia, Cyprus, the islands of the Archipelago. The principal **ports** connected with it are :—Malaga, Valencia, Barcelona (in Spain) ; Marseilles (in France) ; Genoa, Leghorn, Civita Vecchia, Naples, Brindisi, Venice (in Italy) ; Palermo (in Sicily) ; Trieste (in Austria) ; Salonika (in European Turkey) ; Smyrna (in Asiatic Turkey) ; Port Said, Damietta, Alexandria (in Egypt) ; Tripoli, Tunis, Algiers (in North Africa).

(4) **The Black Sea**, connected with the Mediterranean by the Dardanelles, the Sea of Marmora, and the Bosphorus. This sea has the form of a great sunk basin, situated between Russia and Turkey in Asia. Its *length* is about 450 miles ; greatest *breadth*, 230 miles ; *area* (including the Sea of Azof), about 180,000 square miles. Its greatest **depth** is said to be about 3,000 feet. Its water is less salt than that of the ocean, on account of the great rivers which flow into it. On the north is the **Sea of Azof**, connected with it by the Straits of Yenikale

It has no **islands.** The peninsula to the north was the scene of the Crimean war. Some of the largest **rivers** in Europe flow into the Black Sea. Among these are the Don, Dneiper, Dneister, Danube. The principal **ports** connected with the Black Sea are :—Odessa (in Russia); Constantinople (in European Turkey); Trebizond (in Asiatic Turkey); Batoum (in Asiatic Russia).

(5) **The Gulf of Guinea,** formed by the great bend in the west coast of Africa.

II. ON THE WEST.

(1) **Baffin's Bay,** between Greenland and the islands in the northern part of America. It is named after an English navigator, William Baffin, who explored the neighbouring seas in the early part of the 17th century. The entrance to Baffin's Bay from the Atlantic is named **Davis' Strait,** after John Davis, an English navigator, who attempted to discover the north-west passage in the latter part of the 16th century. Most of the English north-polar expeditions have sailed up Baffin's Bay. The whole of the neighbouring seas are blocked with ice during a considerable part of the year. They abound with whales. The larger portion of this great inlet is within the Arctic Circle.

(2) **Hudson's Bay,** an immense land-locked sea, almost entirely surrounded by the British North American territories. It is named after the famous English navigator Henry Hudson, who explored these seas in the beginning of the 17th century. The *area* of this bay is nearly 300,000 square miles. It is blocked up with ice during a great part of the year. The southern portion is named **James Bay** after Thomas James, an English navigator of the reign of Charles I.

(3) **Gulf of St. Lawrence,** at the mouth of the River St. Lawrence. Newfoundland, Prince Edward Island, and Cape Breton Island are washed by its waters.

(4) **Gulf of Mexico** and **Caribbean Sea.** These form one vast gulf, enclosed between the West India Islands, the peninsula of Florida, and the narrow portion of the continent of North America. The Gulf of Mexico receives the waters of the

great river Mississippi. The Gulf Stream issues from the Gulf of Mexico. The Caribbean Sea is separated from it by the peninsula of Yucatan and the island of Cuba.

ISLANDS. The islands of the Atlantic have mostly been described in connection with the countries to which they belong, or the continents to which they are adjacent. The following is a list of the most important :—

Iceland. (*See* Denmark.)

British Islands.

Newfoundland, Prince Edward Island, Cape Breton Island. (*See* British Colonies.)

Bermudas. (*See* British Colonies.)

West Indies. (*See* British Colonies and America.)

Azores, or **Western Islands,** belonging to Portugal. They form a group of nine islands, situated between 36° and 40° north latitude and 25° and 31° west longitude. The north-western group consists of **Flores** and **Cobo**; the central group, **Fayal, Pico, St. George, Graciosa,** and **Terceira**; the south-eastern group, **St. Michael** (the largest) and **St. Mary.** They are rocky, rise abruptly from the sea, and appear to be of volcanic origin. They contain many elevations of a conical shape, the highest of which is the peak of **Pico,** which rises to a height of 7,000 feet. The **climate** is humid, but temperate and healthy. The islands are subject to **earthquakes,** some of which have done much damage to life and property. The **soil** is very fertile, but agriculture is in a low condition. The **population** is about 200,000, chiefly of Portuguese descent. The chief **exports** are wine, brandy, lemons, oranges, and other fruits. St. Michael oranges are well known. The **imports** are manufactured goods from England, spirits and tropical produce from America, tea, coffee, and other colonial produce. The capital is **Terceira,** but the chief town and port is **Ponte Delgada,** in St. Michael, having a population of about 16,000. These islands are said to have been known to Europeans as early as the 14th century.

Madeira Islands. (*See* Africa.)

Canary Islands. (*See* Africa.)

Fernando Po, Prince's Island, St. Thomas, Ascension Island, St. Helena. (*See* Africa.)

THE PACIFIC OCEAN.

This is by far the largest of the great divisions of the water. It covers nearly one-half of the entire surface of the globe. It was first discovered to Europeans by Balboa, a Spanish adventurer, who beheld it from an eminence on the Isthmus of Panama in 1513. The first European navigator who entered its waters was **Magalhaens**, a Portuguese, who sailed into it in 1520, through the Straits of Magellan, which have received their name from him. Finding the waters of the new ocean tranquil after a stormy passage through the straits, he gave it the name of the Pacific Ocean, which it has ever since borne.

BOUNDARIES.

North, the arms of America and Asia, which nearly meet at the narrow channel called Behring Strait.

East, America.

South, the Antarctic Ocean.

West, Asia, the East Indies, and Australia.

EXTENT.

Length, about 10,500 m. (from east to west).

Greatest breadth, about 9,000 m. (from north to south).

GENERAL DESCRIPTION. This vast ocean is of the shape of an immense oval, of which the greatest diameter is from east to west.

It is distinguished by the great number of its islands, which are found in almost innumerable multitudes throughout its waters.

It is contrasted with the Atlantic by the small number of inland seas connected with it. (*See* Atlantic Ocean.) On the western side are five remarkable *land-locked* seas.

Its shores are lined with volcanoes both on the Asiatic and on the American side. Many of the islands it contains are of volcanic origin.

It is divided by the Equator into the **North Pacific** and **South Pacific Oceans**.

The average **depth** is supposed to be about 21,000 feet. The deepest soundings on record have been found in its waters.

It is much less navigated and less known than the Atlantic.

SEAS and **OPENINGS.**

I. ON THE EAST. These are very unimportant.

Gulf of California, between the peninsula of California and the mainland.

Bay of Panama.

II. ON THE NORTH AND WEST. Here we have the five remarkable land-locked seas already alluded to.

(1) **Behring Sea**, named after Vitus Behring, a Russian navigator of the early part of the 18th century. It is enclosed between the projecting arms of Asia and America and the Aleutian Islands. It is connected with the Arctic Ocean by Behring Strait.

(2) **Sea of Okhotsk**, east of Siberia. It is enclosed by the peninsula of Kamtschatka, the Kurile Islands, and the island of Saghalien.

(3) **Sea of Japan**, east of China, and enclosed between the Japan Islands and the mainland. It contains the *Gulf of Tartary*.

(4) **Yellow Sea**, or Hoang Hai, east of China. It is enclosed by the Loo Choo Islands and Formosa. It contains the *Petchili Gulf*. It is said to derive its name from its yellowish, muddy appearance, caused by the nature of the soil beneath its waters, which are very shallow.

(5) **Chinese Sea**, enclosed between the mainland and Borneo, the Philippine Islands and Formosa Island. It contains the *Gulfs of Siam* and *Tonquin*.

ISLANDS. As already observed, islands form the distinguishing feature of the Pacific Ocean. On the west is the immense group called the East Indies, which, taken in connection with Australia, Tasmania, and New Zealand, constitute the largest system of islands in the world.

Scattered over the vast area of the Pacific are the countless thousands of islands which together have received the name of **Polynesia** (*many islands*). A large number of these are of volcanic origin. Some contain active or extinct volcanoes.

Coral Islands. Others are of coral formation, having been partly constructed by the labours of the coral insect. Myriads of these tiny creatures are engaged in the formation of a single island. They probably commence their operations on a rock sunk several fathoms beneath the surface of the ocean. By unceasing exertions they build up on this a coral reef which reaches to the surface of the water, where their labours cease, since they cannot exist out of their native element. The reef is now increased in height by the action of the waves, which break off pieces of coral and throw them up on the firm portions. Thus coral formed beneath the surface is made to swell the height of the reef. Trees, sand, seaweed, and other substances are washed up by the surf, and form a soil on the island. Seeds and plants carried thither by the tides and currents furnish the land thus brought into existence with vegetation. Palm-trees shoot up into the air, and birds come and build their nests in the foliage. Most of these islands are constructed in the form of a circular ring, enclosing a **lagoon**, or salt-water lake, protected from the action of the outside waves by the intervening rock. Coral islands have been found containing lagoons measuring 30 miles in diameter. A coral island containing a lagoon is termed an **atoll.**

The following are the principal islands in the Pacific Ocean :—

Japan Islands, Formosa. (*See* Asia.)

Australia, Tasmania, New Zealand. (*See* British Colonies.)

East India Islands, between the Pacific and Indian Oceans.

Polynesia. These two systems must be treated in separate sections.

A. EAST INDIA ISLANDS.

This immense group lies between Asia and Australia, and between the Indian and Pacific Oceans. We use the term in its largest meaning, as including all the islands in the whole

system, sometimes called the **Indian Archipelago**, or **Islands of the Western Pacific.** The principal islands and island groups are the following:—

(1) **Borneo**, the largest island in the world, with the exception of Australia (and Greenland, if regarded as an island). Its *length* is about 800 m., its *greatest breadth* about 700 m., and its *area* about 270,000 sq. m. The equator passes through it, and its **climate** is hot and humid. The interior is little known to Europeans, but is supposed to be mountainous. The highest known summit is **Kina-balow**, which attains an elevation of about 14,000 ft. It contains large **forests** of teak and other timber trees, besides furnishing dye-woods, cinnamon, nutmegs, pepper, and other spices, together with tropical fruits. Its **rivers** are scarcely known except near their mouths. It is rich in **minerals**; gold, tin, iron, and diamonds are found. The **population** has been vaguely estimated at 3,000,000, consisting of Dyaks, Malays, Chinese, Papuans, Hindoos, and a few Europeans on the coast. The Dutch have formed a few settlements, and carry on an irregular trade with the natives. There is no general **government**, but there is a Sultan of Borneo, and several kingdoms are established in various parts of the island. Borneo was discovered by the Portuguese in the beginning of the 16th century. The chief town is **Borneo**, on the north-west coast. **Sarawak** is a district in the north-west under the protection of Great Britain, which also possesses the neighbouring island of **Labuan.**

(2) **Papua**, or **New Guinea**, the second largest of this group, lies at a considerable distance to the south-east of Borneo. Its *area* is about 250,000 sq. m. On the south is Australia, from which it is separated by Torres Strait; on the west are the Moluccas. It is naturally divided into two portions united by a narrow isthmus, which forms the southern boundary of a large opening called Geelwink, or Great Bay. The coasts are generally rocky, and the interior is supposed to be mountainous, but it is almost entirely unknown. It contains vast **forests**, producing yams, cocoa-nuts, bananas, etc., and abounding in wild

animals and birds of beautiful plumage, parrots, cockatoos, birds of paradise, and many others. The Dutch are said to possess this island, but their claim is only nominal. The inhabitants are Negroes, Malays, Papuans, and other uncivilized tribes.

(3) **Sumatra,** one of the **Sunda Islands,** which extend in a curve from the continent of Asia towards the northern coasts of Australia. It is separated from the Malay peninsula by the Strait of Malacca. Its *length* is about 1,000 m., and *area* about 150,000 sq. m. It is divided by the equator into two nearly equal portions. The **surface** is mountainous, the highest elevation being **Indrapura,** 12,000 ft. in altitude. The **climate** is mild for the latitude; the **soil** is fertile in many parts. The chief **vegetable productions** are pepper, cassia, camphor, rice, coffee. The **forests** produce excellent timber. Gold, iron, copper, and other **minerals** abound. The **population** is estimated at from four to five millions. Several distinct **governments** rule various parts of the island. The Dutch have settlements on the east coast, and lay claim to the whole of Sumatra. The natives are little better than savages. There are no important towns.

(4) **Java,** the second largest of the Sunda Islands, lies to the south-east of Sumatra, from which it is separated by the Strait of Sunda. On the north is the Sea of Java, which divides it from Borneo. Its *area* is about 45,000 sq. m. It is the most populous and important island of the whole East Indian Archipelago. On the east is the small island of **Madura,** which is generally considered as forming part of Java, from which it is separated only by a narrow strait. It is traversed by a range of **mountains,** many of which are volcanoes, which rise to a height of about 13,000 ft. The **climate** is hot and somewhat unhealthy near the coasts, but mild and sometimes even cold in the interior. The **soil** is mostly very fertile. The chief **vegetable productions** are teak, palm, and other trees, including the famous upas tree (from which poison is said to be extracted), cocoa-nuts, tropical fruits, yams, rice, sugar, coffee,

pepper, cotton. Cattle, sheep, and other **domestic animals** are reared in considerable numbers. **Wild animals** of the usual Asiatic kinds abound. The island is held by the Dutch, who have important settlements on the coast. The **population** is said to be about 10,000,000, chiefly Malays. The capital is **Batavia**, a city containing upwards of 100,000 inhabitants. This town is the principal seat of Dutch commerce and power in the East Indies, contains the residence of the Governor-general of the Dutch possessions, and carries on an extensive trade with India and Europe.

The Sunda Islands are continued to the east of Java. The principal are **Bally, Lombock, Sumbawa, Florez, Timor.** They all belong to the Dutch, with the exception of Timor, part of which is held by the Portuguese.

On each side of Sumatra is a chain of smaller islands, none of which are of great importance.

(5) **Celebes**, an island of very irregular shape to the east of Borneo, from which it is separated by the Strait of Macassar. Its *area* is about 72,000 sq. m. The central part is mountainous. It is situated on the equator; the **climate** is hot, but tempered by the ocean and by heavy rains. There is much fertile **soil**, little of which is cultivated. Forest trees and wild beasts are numerous. Its chief **productions** are rice, ivory, gold, timber, pepper, cattle. Its **population** is estimated at about 2,000,000, chiefly Mohammedans. It is divided into several kingdoms, some of which are under the influence of the Dutch, who have considerable settlements on the island. Their chief town is **Macassar**, in the south-west.

(6) **The Moluccas**, or **Spice Islands**, a numerous group of islands between Celebes and New Guinea. The principal are **Gilolo, Booro, Ceram**, and **Amboyna.** The latter is, next to Batavia, the chief Dutch settlement in the East Indian Archipelago. Most of the islands are of volcanic origin. The **climate** is hot, but humid and generally healthy. The chief **productions** are ebony and other kinds of wood, clove, nutmeg, and other spices, sago, cocoa-nuts, tropical fruits. The Dutch

claim sovereignty over these islands, and possess a considerable commercial settlement at Amboyna, which contains a population of about 40,000.

(7) **Philippine Islands**, north of Borneo and Celebes, from which they are separated by the Celebean Sea. These islands form the eastern boundary of the Chinese Sea. This group is said to consist of more than 1,000 islands. The largest are **Luzon** (*area*, 60,000 sq. m.), **Mindanao**, **Palawan**, **Samar**. They are of volcanic origin, and their surface is mountainous. The **climate** is mild for the latitude, but hurricanes and earthquakes are frequent. There is much fertile **soil**, but it is not well cultivated. The chief **productions** are rice, sugar, indigo, coffee, ebony, and other woods. The **population** is about 5,000,000, many of whom are Chinese and Malays. These islands are claimed by Spain, which holds an extensive settlement at **Manilla**, on the west coast of Luzon. The population of this settlement is about 120,000, but only a few thousands are Spaniards.

B. POLYNESIA.

This name is given to the thousands of islands scattered over the Pacific Ocean between the East Indian Archipelago and Australia on the west and the coast of America on the east. They are mostly small, the only large islands being **New Zealand**, which has been described in our book for Year II. The others are chiefly of **volcanic** or **coral** formation. The **climate** is generally warm, but tempered by the moderating influence of the ocean, and varying to some extent according to the latitude. The chief **productions** are banana, cocoa-nut, yam, arrow-root, sugar, the vine, orange, bread-fruit, sweet potato, mulberry and other fruits, coffee, cotton, tobacco. Corn is grown in some of the islands. The natives belong mostly to the Malay and Papuan races. The following are the principal islands and island groups :—

I. NORTH OF THE EQUATOR.

(1) **Caroline Islands**, an extensive group lying to the east of

the Philippine Islands. It contains some hundreds of islands, mostly of coral formation. They are not much known. Their **productions** are of the kinds usually found in the islands of Polynesia. West of the Caroline Islands are the **Pelew Islands**, belonging to the same system.

(2) **Ladrone Islands**, or **Marianne Islands**, lying to the north of the Caroline Islands. The former name was given to them by Magellan, on account of the thievish habits of the inhabitants (Lat. *latro*, Span. *ladron*, a robber). The bread-fruit tree and other vegetable productions common to the islands of the Pacific flourish here. Most of the islands are of volcanic origin. They are claimed by Spain. The largest island is **Guahan.**

(3) **Sandwich Islands**, in the centre of the North Pacific Ocean, occupying an important position nearly midway between Asia and America. They were discovered by **Captain Cook** in 1778, who named them after the first lord of the admiralty of that time. The group contains thirteen islands, having an area of about 6,000 sq. m. The principal are **Hawaii**, or **Owhyhee** (4,000 sq. m.), where Captain Cook was murdered by the natives in 1779, **Oahu**, **Maui**, **Kauai**, and **Molokai.** The whole of these islands are of volcanic origin. They contain several lofty mountains, of which **Mouna Loa** and **Mouna Kea**, the highest, rise to an elevation of about 15,000 ft. The **productions** are of the usual Polynesian kinds. The **natives** are a mild and peaceable race who have been converted to Christianity, and are tolerably civilized. The **population** is about 80,000. The chief town is **Honolulu**, the chief port, and residence of the sovereign, having a population of about 10,000.

Other less important groups are the **Bonin Islands**, between the Ladrone Islands and Japan; **Marshall's Islands** and **Gilbert's Islands**, to the east of the Carolines.

II. SOUTH OF THE EQUATOR.

(1) An extensive system of islands lying to the south-east of New Guinea. They are little visited, and not well known. The principal are **New Britain** and **New Ireland** (east of

New Guinea); **Solomon's Islands**, the largest of which is **New Georgia**; **Queen Charlotte's Islands**; **New Hebrides**; **New Caledonia.** The latter is a large and mountainous island discovered by Captain Cook. Its soil is not fertile, but it produces the bread-fruit tree, sugar-cane, and other vegetable products of the Pacific Ocean.

To the south-east of New Caledonia is **Norfolk Island**, belonging to England. (*See* Colonies.)

(2) **Friendly Islands**, lying to the east of the New Hebrides, were discovered by Captain Cook, who gave them this name on account of the kind treatment he received from the natives. Their assumed appearance of friendship was, however, only a mask intended to conceal treacherous intentions towards him. This is an extensive group, comprising more than 150 islands, some of which are mountainous and volcanic. The largest is **Tongataboo**, which is of coral formation. They **produce** bread-fruit, cocoa-nuts, yams, wild-fowl, etc. The **inhabitants** are of the Malay race; many of them have embraced Christianity.

(3) **Fiji Islands**, belonging to England. (*See* Colonies.)

(4) **Navigator's**, or **Samoa Islands**, lying north of the Friendly Islands. These are volcanic and mountainous. The largest is **Savaii**, which rises to an elevation of about 3,000 ft. The **inhabitants** appear to be of Malay origin; they are fierce and warlike. These islands abound in bread-fruit, cocoa-nuts, bananas, and other Polynesian products.

(5) **Society Islands**, lying to the east of the Friendly Islands, form one of the most important groups in the Pacific Ocean. They were discovered in 1769 by Captain Cook, who named them in honour of the Royal Society. They are of volcanic origin, and mountainous. The largest is **Tahiti**, or **Otaheite**, which has an area of about 600 sq. m., and rises to a height of about 12,000 ft. The **inhabitants** number about 20,000, of Malay origin, but mostly converted to Christianity. The chief **productions** are bread-fruit, cocoa-nuts, bananas, yams, sugar-cane, etc. Pigs, dogs, poultry, and other useful animals abound. These islands were taken possession of by France in 1880,

having been under French protection since 1842. The chief port is **Papiete.**

(6) **Cook's Islands,** of volcanic origin, lying to the east of Navigator's Islands.

(7) **Austral Islands,** lying to the south-east of the Society Islands.

(8) **Low Archipelago,** lying to the east of the Society Islands, and comprising an immense number of small islands of coral formation. They are mostly uninhabited and dangerous to navigation. Hence they have sometimes been called the **Dangerous Archipelago.**

(9) **Gambier Islands,** a small group, mostly of coral formation, lying to the south-east of the Low Archipelago.

(10) **Pitcairn's Island,** a volcanic island lying to the east of the Low Archipelago. It has a mild climate and fertile soil. It is celebrated as having been settled by some of the mutineers who took possession of the ship *Bounty* in 1789, and set the captain with his officers adrift in a small boat. The descendants of the mutineers removed to Norfolk Island in 1855.

(11) **Easter Island,** a rocky island lying to the eastward, and having an area of about 115 sq. m. It contains the craters of extinct volcanoes.

(12) **Marquesas Islands,** a group of islands lying north-east of the Society Islands. They are mountainous, rising to a height of about 5,000 feet. The largest is **Noukahiva.** The **inhabitants** are a savage race of Malay origin, and number about 20,000. These islands were discovered by Mendan, a Spanish navigator, in 1595, and named in honour of the Marquis of Mendoza, then Viceroy of Peru. The **productions** are of the kinds common to the islands of the South Pacific.

Other islands in the Pacific Ocean have been mentioned in connection with the continent of America.

THE INDIAN OCEAN.

The Indian Ocean is in the form of a semicircle.

It derives its name from the fact that its waters wash the coasts of India.

BOUNDARIES.

West, Africa.
North, Asia.
East, East India Islands and Australia.
South, the Antarctic Ocean.

EXTENT.

Length, about 6,000 m.
Breadth, about 4,000 m.
Area, about 20,000,000 sq. m.

GENERAL DESCRIPTION.

The Indian Ocean, like the Pacific, has land to the north of it.

It is characterized by open bays. It has only one inland sea (the Red Sea).

It has few islands.

Its temperature is more uniform than that of the Atlantic and Pacific, since it extends through a much smaller number of degrees of latitude.

SEAS and OPENINGS.

(1) **Bay of Bengal,** on the east of Hindostan, containing the *Gulf of Artaban.*

(2) **Arabian Sea,** west of Hindostan, containing the *Persian Gulf.*

(3) **Red Sea,** between Arabia and Africa.

(4) **Mozambique Channel,** between Africa and Madagascar.

ISLANDS. These have mostly been described in other parts of this Course. The principal are :—

Andaman Islands.
Ceylon.
Maldive Islands.
Laccadive Islands.
Seychelles.
Socotra.
} (*See* Colonies.)

Madagascar.
Comoro Islands.
Bourbon.
} (*See* Africa.)

Mauritius. (*See* Colonies.)

St. Paul's Island. } Two islands in the southern part of the
New Amsterdam. } Indian Ocean. They appear to be of volcanic origin, have much fertile soil, and abound in sea-fowl. Seals are found in large numbers on the coasts.

Kerguelen's Land, in the extreme south of the Indian Ocean, is a large island, not much known. It is very rocky and barren, so that it has been called Desolation Island. Sea-fowl are numerous.

The East India Islands, which lie to the east of the Indian Ocean, have been described in connection with the Pacific. Sumatra and Java belong more properly, perhaps, to the Indian Ocean

THE ARCTIC OCEAN.

This ocean surrounds the north pole, and extends as far south as the **Arctic Circle,** which passes round the earth at a distance of $23\frac{1}{2}°$, or about 1,600 miles, from the north pole.

It is connected with the Pacific Ocean by Behring Strait.

It is **bounded** on the south by the northern coasts and islands of Europe, Asia, and America, and by the Atlantic Ocean, from which it is divided by the Arctic Circle.

It derives its name from the Greek word *arktos*, a bear, because the northern constellations called the **Great Bear** (Ursa Major), or Charles's Wain, and the **Little Bear** (Ursa Minor) shine over it. Almost exactly over the north pole shines the **Pole Star** (belonging to the constellation of the Little Bear), which appears to keep its place while the other stars seem to revolve round it. This motion is, however, only an apparent one, like that of the sun from east to west, and is due to the same cause, the diurnal revolution of the earth on its axis.

No one has ever succeeded in reaching the north pole, though many attempts have been made to do so. The vast fields of solid ice which surround the pole have hitherto prevented all the efforts of navigators to arrive there; but sanguine hopes of ultimate success are still entertained.

DAY AND NIGHT. In the extreme polar regions the year consists of only one day and night. The day is six months long, during which the sun is above the horizon the whole time. When the sun sets it does not appear again till the end of another period of six months, which constitutes the Arctic night. The obscurity of this long period is often interrupted by the phenomenon called the **Aurora Borealis**, or Northern Dawn, which sometimes shows itself in a fainter form in this country. In the Arctic regions it shines with great splendour, taking the shape of a magnificent golden arch, shooting out rays of different colours, and illuminating the surface of the earth with its brilliant light.

TEMPERATURE. During the long night and winter of the polar regions the cold becomes intense. Mercury freezes at 40° below the freezing point of water in the centigrade thermometer. During the voyage of the *Vega* the spirit thermometer fell to about 45° below the freezing point of water, and even greater degrees of cold than this have been registered within the Arctic Circle. In most parts the mean annual temperature is below freezing point, and in some places even the mean temperature of the *summer* months is below freezing point. Hence even the water of the ocean becomes frozen, vast masses of snow and ice are collected on the land, and immense glaciers or fields of ice, slowly moving down the valleys, are formed between the declivities of opposite hills.

ICEBERGS. When a glacier flows down to the sea, parts of it which have arrived at the shore break off, float in the water, and become icebergs. These are borne away by the winds and tides into the ocean, and are carried southward by the currents which move towards the equator. On arriving in warmer water they gradually thaw, break up, and melt away. Vessels crossing the Atlantic Ocean often meet with icebergs, which are very dangerous to navigation. Ships are in danger of being run down by them as they float majestically along. Sometimes a vast mass of ice falls from an iceberg on a vessel which has approached too near, and in other cases ships have been crushed between two icebergs. Another source of danger arises

from the wearing away of that part of an iceberg which is under water. This causes the whole mass to topple over suddenly and fall on any unfortunate vessel which has approached too near under a mistaken belief that the iceberg was perfectly sound.

Icebergs are often of vast size, sometimes rising two or three hundred feet above the surface of the ocean, and having a circuit of some miles in length. As only about a tenth part of the iceberg appears above the water, the enormous size of the whole mass may be imagined. Icebergs are of a bluish-green tint, and often assume the most fantastic forms, resembling huge towers or steeples surmounted by pointed pinnacles.

A large expanse of floating ice with a flat surface is called an *ice-field;* if the field is of smaller size, it is termed a *floe.* A field or floe when broken up into fragments is called *pack-ice;* if the fragments are sufficiently small and loose to allow a ship to sail among them, they are termed *drift-ice.*

Icebergs abound in the Arctic regions. They are particularly numerous in Baffin's Bay, where they are formed from the vast glaciers which slide down the mountain slopes of Greenland. They are met with in the Atlantic Ocean occasionally as far south as 40° north latitude.

ANIMAL LIFE. The intense cold of the Arctic regions is unfavourable to animal life. The higher types are wanting. The open spaces of water between the ice-fields are frequented by whales, walruses, seals, and other aquatic animals. On the shores and on the ice itself are found the white bear, the reindeer, the Arctic fox, the sable, the ermine, the lynx, and other fur animals. The Arctic regions are visited by hunters who come to obtain the skins of these animals, and by men engaged in the whale fisheries. Sea-fowl abound, and flocks of birds arrive from the south during the summer months.

The inhabitants of the Arctic regions are few in number and of stunted growth. The **Esquimaux,** who inhabit Greenland, attain an average height of about five feet. They live in houses built of snow and ice during the winter; in the summer they inhabit huts made of earth and bushes or tents formed of skins

stretched on poles. They live on the flesh of the seal, walrus, and other northern animals. They carry on an irregular trade in skins and other Arctic products with voyagers who visit their shores. The **Laplanders** live on the southern shores of the Arctic Ocean, in the most northern part of Europe. They attain the average height of scarcely five feet. They are somewhat more civilized than the Esquimaux. They live in tents in summer and in huts of earth and boughs of trees in winter. Their food is the flesh of the reindeer and fish. The reindeer is their most useful possession ; it draws their sledges, and provides them with flesh and milk. The Laplanders engage in some rude manufactures, as tanning hides, coarse weaving, and making sledges and other wooden articles.

VEGETABLE LIFE. The vegetable life of the Arctic regions is also of inferior types and of stunted growth. In the southern part of these regions forests of pine and other northern trees abound. The dwarf birch and willow are found in Greenland. Farther north all trees disappear. There mosses, lichens, hardy grasses, and a few flowers of the lowest types clothe the ground in the more favoured spots, while in the extreme north vegetation disappears altogether, and only one dreary scene of snow and ice presents itself to the view.

SEAS, OPENINGS, and **STRAITS.** These have already been given in connection with the geography of the continents The principal are :—

(1) CONNECTED WITH EUROPE.

White Sea (only partly within the Arctic Circle), **Sea of Kara** (between Nova Zembla and the mainland).

(2) CONNECTED WITH ASIA.

Gulf of Obi, Gulf of Yenisei.

(3) CONNECTED WITH NORTH AMERICA.

Banks' Strait, Melville Sound, Barrow Strait, Lancaster Sound, Dease Strait, Gulf of Boothia, Coronation Gulf, Baffin's Bay, Smith's Sound.

ISLANDS. The following is a list of the most important of the islands in the Arctic Ocean :—

Nova Zembla, or New Land, the name of two large islands to the north of Europe and Asia, from which they are separated by the Sea of Kara and the Strait of Vaigatz. These islands belong to Russia. Their *area* is about 95,000 sq. m. They form a desolate and barren region, mostly flat, but having a range of mountains rising to the height of about 2,000 ft. The climate is very severe in winter; dwarf willows, stunted shrubs, lichens, and mosses are the only vegetation. There are no inhabitants, but the islands are visited by hunters for the sake of furs. White bears, foxes, walruses, reindeer, whales, seals, and waterfowl abound. Between these islands and the mainland lies the smaller island of **Vaigatz.**

Kolgouer Island, south-west of Nova Zembla, near the coast of Russia in Europe.

Lofoden Islands, near the coast of Norway.

Spitzbergen (pointed mountains), or **East Greenland,** a large group of islands belonging to Russia, and situated about 420 miles from North Cape, in Europe. They were discovered in the 16th century by Sir Hugh Willoughby. They consist of four principal islands and a number of smaller islands, some being mere rocks. The surface is rocky and mountainous. Some peaks rise to a height of about 4,000 ft. Immense glaciers line the coast, and form vast icebergs. The soil is frozen and barren; few vegetable productions are found. White bears, foxes, reindeer, seals, and other Arctic animals abound. These islands are visited occasionally by hunters, and by sailors engaged in the whale fishery.

Bear Island, south of Spitzbergen.

Jan Mayen Island, lying to the east of Greenland in latitude 71° N. It contains an active volcano, rising to the height of nearly 7,000 ft.

Greenland. (*See* page 6.)

Franz-Josef Land, discovered in 1873, lies to the north of Nova Zembla, and extends from 80° north latitude to an un-

known distance towards the north pole. Its coasts have been only partially explored, but it appears to be a large group of islands.

North Devon, Melville Island, Cockburn Island, Banks' Land, Prince Albert Land, Prince of Wales Land, Bathurst Island, and many others belong to an immense archipelago situated to the north of North America. They are all desolate and ice-bound, and marked by the usual character of the Arctic regions. They are divided from each other by a great number of narrow straits and channels.

Wrangel Land, or **Kellet Land,** north of Siberia.

New Siberia, a group of islands to the north of Siberia.

THE ANTARCTIC OCEAN.

Most of the remarks which have been made with regard to the general character of the Arctic Ocean apply also to the Antarctic Ocean.

The Antarctic Ocean surrounds the south pole, and extends as far north as the Antarctic Circle, which passes round the earth at a distance of $23\frac{1}{2}°$, or about 1,600 m., from the south pole.

It has no land **boundaries.** It is bounded on the north by the Pacific, Atlantic, and Indian Oceans.

Its name is formed by the addition of the Greek preposition *anti* (opposite to), to the word "Arctic," which has been already explained.

The Antarctic is even less known than the Arctic Ocean. The chief Antarctic explorer was—

Sir James Clark Ross (1800–1862). He was appointed to the command of the *Erebus* and *Terror* in 1839, when these vessels were sent on a scientific expedition to the south-polar regions. He penetrated as far as 78° 4′, and explored the coast of South Victoria Land, supposed to form part of a great Antarctic continent, for about 700 m. He saw an immense volcano, rising to the estimated height of 12,000 ft. above the sea, when in a state of eruption, and called it Mount

Erebus, after the name of his ship. This mountain appeared to be one of an extensive chain.

Icebergs are as numerous in the Antarctic as in the Arctic Ocean. Many were seen from the *Challenger* during its visit to the Southern Ocean. They were mostly of tabular form and of a generally uniform height of about 200 ft. above the level of the sea. They varied in length from one or two to eight or ten miles.

The Antarctic regions seem to be quite destitute of **vegetable life.** Not even the mosses and lichens of the Arctic regions are seen here. No **quadrupeds** are found, but **sea-birds** are numerous, and the **whale, seal,** and **dolphin** inhabit the waters. No **human beings** are to be seen.

Land has been discovered at various places, and it is conjectured that the south pole is surrounded by a great continent. These portions of land have received different names, as **South Victoria Land, New South Shetlands, New Orkneys, Trinity Land, Louis Philippe Land, Enderby's Land, Terre Adélie, Wilkes' Land,** but none of them have been explored, and attempts to penetrate farther into the south-polar regions have been unsuccessful.

QUESTIONS FOR EXAMINATION.

The following questions are selected from previous Government Examination Papers. The answers to a few of them are here given as models.

1. *Though the area of the Pacific is much the larger of the two great oceans, its basin is computed at not half that of the Atlantic.* How is this? Explain the statement, and show in detail that it is true.

2. Describe fully the *physical features* of Mexico.

3. Give notes to an *advanced* class on *latitude and longitude,* and illustrate it by drawing an outline map of South America, supposing the following facts to be known beforehand, viz. :—

(*a*) Cape Horn is in about 55 degrees of south latitude;

(*b*) The north coast extends from 10 to about 14 degrees of north latitude;

(*c*) Quito and the mouth of the Amazon are almost exactly on the equator;

(*d*) Cape St. Roque is in about 5 degrees of south latitude;

(*e*) Rio de Janeiro is very nearly on the tropic of Capricorn;

(*f*) The whole continent lies between the 35th and 82nd meridians of west longitude;

You should show the children how, knowing these facts, you can make use of them to secure exactness in the proportion of your outline.

N.B.—*A map not used for this purpose will be of no value.*

4. Name, in order, the countries and colonies on the west coast of America, and say what you know about each of them.

5. Give notes of a lesson on "The Gulf Stream," and illustrate it by a full map of the Gulf of Mexico.

6. Write a short letter as from a traveller just returned from a tour in British North America and the United States, describing the chief objects of interest which he had seen.

7. Give notes of a lesson to an advanced class on "The Tides—the causes of them, and why they are higher at some periods than at others."

8. Draw a full map of the basin of the Mississippi.

9. Draw a map of the coast-line of the Indian Ocean.

10. What are the principal *currents* of the ocean? Describe them, and explain the word "Current."

11. What are the chief physical differences between the "Old World" and the "New World"? Answer as fully as you can.

(In the following answer we understand the "Old World" to mean Europe, Asia, and Africa, without Australia.)

(1) The Old World is much larger than the New World. Asia alone is larger than North and South America together.

(2) The Old World lies principally to the north of the equator, and is situated chiefly between the tropics and in the north

temperate zone. The New World extends almost equally into the northern and southern hemispheres.

(3) The Old World extends chiefly from east to west; the New World from north to south.

(4) Similarly, the chief ranges of mountains extend, in the Old World, from east to west, and in the New World from north to south.

(5) The Old World contains a larger number of inland seas and peninsulas than the New World.

(6) The Old World presents a greater variety of structure than the New World. The Old World contains mountain chains, table-lands, and plains stretching in every direction, and presenting every variety of conformation. The New World is of much more simple structure; it is characterized mainly by one great mountain chain, extending from north to south, at a comparatively short distance from the west coast, and dividing the entire continent into an eastern and western region, of generally level surface.

(7) The Old World contains the highest mountains in the world; the New World contains the largest rivers.

(8) The Old World contains vast table-lands and deserts. Those of the New World are small in comparison.

(9) The New World contains the largest freshwater lakes. There is nothing in the Old World to compare with the vast system of lakes in North America.

(10) The climate of the New World is more humid than that of the Old World.

(11) Hence vegetation is more luxuriant in the New World than in the Old World.

(12) On the other hand, the animal life of the Old World is superior to that of the New World. The lion, tiger, elephant, of the Old World are higher types of animal existence than the jaguar, puma, etc., of the New World. The higher kinds of mammalia abound in the Old World; reptiles and insects in the New World. Similarly, comparing the different races of mankind, the Old World has produced by far the highest types

the numan race, both in regard to physical structure and to intellectual powers.

12. *Mountains, and not rivers, are the usual boundaries between different countries.* Explain this statement, show by a variety of instances that it is generally true, and give reasons why it should be so.

13. "*The curious sight is here presented of rivers rising within a short distance of one ocean and being compelled to traverse thousands of miles to cast themselves into another.*" To what continent does this statement apply? Show as you would to an advanced class that it is true, and draw sketch maps illustrating the course of two or three of these rivers.

14. Describe the mountain and river system of the United States.

15. Where and what are Buenos Ayres, Chicago, Cayenne, Chimborazo, Cotopaxi, Demerara? Say what you know about each.

16. Give full notes of a lesson on the following passage:—

"On looking at the globe, three things strike us":—

(*a*) How much more water there is than dry land.

(*b*) How unequally the land is divided between the northern and the southern hemisphere.

(*c*) How the land collected in the northern part of the world seems to be everywhere *reaching down towards the south.*

17. Name in order the countries of South America, and describe briefly the features and character of each.

18. Name the principal towns in the United States, and describe the situation and character of each.

19. A ship sails from New York to Liverpool, calling at Halifax, St. John, and Cork. Describe her voyage fully as for children.

20. Draw a map of the North Pacific Ocean.

21. Give notes of a lesson on "Oceans and Seas," under these heads:—

(*a*) Proportions of "land and water";

(*b*) Size of the different oceans;

(*c*) Peculiar features of each ocean ;

(*d*) Seas connected with each ;

(*e*) Uses of oceans and seas. -

Draw little sketch maps to illustrate your lesson.

22. Describe as fully as you can the physical features, productions, and constitution of the United States.

23. "*Constantinople, Gibraltar, Suez, and Aden are all keys of important outlets.*" Show as you would to children that this statement is true.

24. Say what you know about the Arctic Ocean.

25. Describe fully the basin and course of the Amazon.

26. What are *currents*, *waves*, and *tides?* and how do they differ from each other? What are the chief currents of the Atlantic Ocean?

27. What are the chief differences between the Atlantic and Pacific Oceans?

28. Describe as fully as you can California, Mexico, and Patagonia.

29. Give notes of a lesson on the islands of the Pacific Ocean.

30. Give notes of a lesson on "Climate." Explain the causes of the differences of climate, and give illustrations from different parts of Asia, Africa, and America.

I. **INTRODUCTION.** Commence by asking the children about the weather. What kind of weather is it to-day? What kind of weather had we yesterday? last Christmas? Show from the various answers that when we speak of the weather we generally describe it as hot or cold, fine or rainy. Thus we say it is hot weather, cold weather, dry weather, fine weather, wet weather.

When it rains in England, does it rain everywhere else? No; in some other countries the weather is fine. It does not rain all over the world at the same time. So it is hot in one part of the world at the same time that it is cold in another part.

Again, some portions of the earth are generally hot, others

are generally cold, and others are temperate. So also some countries have much rain, others are dry, and others are moderately humid.

Give the term **climate**, as denoting the nature of any region when considered chiefly with reference to its **temperature**, the quantity of **rain** which falls, and the number of rainy days.

Thus we have cold climates, hot climates, temperate climates, dry climates, and rainy climates. Ask the children for the names of countries with each kind of climate.

II. CAUSES OF DIFFERENCES OF CLIMATE.

(*a*) **Position with regard to the equator.** Show that the rays of the sun fall perpendicularly on the equator, and obliquely on the regions near the poles. Near the equator the sun shines overhead; his rays are very powerful, and cause great heat. Near the poles the rays of the sun fall obliquely, and have little force. If you wish to roast a piece of meat, where should it be placed? Immediately in front of the fire, so that the heat may fall directly on it. Hence countries on or near the equator are hot; those near the poles are cold; those midway between the equator and the poles are temperate. Thus the central parts of Africa are hot; Greenland is cold; Cape Colony is temperate.

Why is England hotter in summer than in winter? Because the sun is then north of the equator, and he shines more directly over our heads than in the winter, when he is south of the equator. Call on the children to observe the position of the sun at noon in summer and in winter.

(*b*) **Elevation.** Some places near the equator are not very hot. Why is this? Because they are elevated considerably above the level of the sea. Point out that the higher we ascend the colder we find it. Children may observe this to some extent by ascending the neighbouring hills. Even near the equator some mountains are so high, that the snow on them never melts. Give the term **snow-line**. Quito, situated on the equator, in South America, has a mild climate, because it lies at an elevation of 9,000 feet.

(*c*) **Position with regard to the sea.**

Places near the sea are more humid than those more remote. Since the sea is the great source of clouds and of rain, maritime countries are more humid than inland regions. Thus Newfoundland is a humid country; the central table-land of Asia is dry.

Again, land receives heat more readily than water, and parts with it again more rapidly. Hence the sea has a more even temperature than the land, and consequently places near the sea partake of the same uniform character. Regions distant from the ocean have greater extremes of heat and cold than maritime countries. Thus in North America the countries near the west coast have an equable temperature, while the great central plain is very hot in summer and very cold in winter.

(*d*) **Position of the mountain chains.**

Mountains sometimes make a country warmer, by keeping off the cold winds, sheltering it like a wall. Thus India is sheltered from the northern winds by the Himalaya Mountains and the great central table-land of Asia.

On the other hand, mountains sometimes make a country colder, by keeping off the warm winds. Thus Siberia is rendered colder by the great mountain system at the south, which forms a barrier against the warm winds from the south.

Other causes of climate, such as the general slope of a country, its prevalent winds, the nature and direction of currents, the character of its soil, the number and extent of its forests, its degree of cultivation, etc., would form the subject of another lesson.

31. Give notes of a lesson on "Latitude and Longitude," the lines by which they are marked, and the uses of these lines, especially to those at sea. Give examples in illustration.

(1) How do we describe the position of a town, or other place on the land? We say it is so many miles east, west, north, etc., of another place. Or we say it is on such a river, or in such a county or province. We describe its position by

comparing it with that of some other fixed point which is supposed to be known. Give examples. Ask children to describe the position of London, Constantinople, Land's End, etc.

So, if a traveller wishes to describe the position of the spot to which he has arrived, he says that it is so many miles in a certain direction from some other place known to those with whom he is communicating.

(2) Can these methods be employed at sea? Not very well, since there are few fixed points convenient for comparison; the sea has no provinces with fixed boundaries, nor has it any rivers running through it which can be used to describe position. Besides, on the land a certain point can be marked in various ways—by fixing up a column, a heap of stones, a post, etc. This cannot be done at sea; there the position must be marked by a *description* of it. Illustrate by pointing to a spot in the midst of the ocean, and asking the children to describe its position. Show them the difficulty of doing so accurately. Also show them that a ship at sea is out of sight of land, has nothing but water for miles around, and the sailors are therefore unable to refer to the land in order to describe their position.

(3) Draw a straight line on the black-board. Suppose that I say that a certain point is nine inches from that line, could you then show me the position of the point? No, because it might be nine inches from *any part* of the line, and on *either side* of it. Now draw another line at right-angles to the former one. Suppose I now say that the point is nine inches from the first line and three inches from the second, could you then fix the position of the point? No, because it might be *on either side* of either of the lines. What more is then required? That you should state on *which side of each line* the point lies. Suppose, then, I say that the point is nine inches *above* the first line, and three inches to the *right* of the second, could you then fix the position of the point? Yes. (Exhibit these details clearly on the black-board, take certain points, and show that the position of any point can be thus defined.)

We see then that it is necessary to state the distance of any point from each line, and also on which side of each line the point lies, in order to fix its position accurately.

(4) Take a globe or ball to represent the earth. Let two opposite points represent the poles. Then a circle drawn round the earth midway between the poles will represent the equator. Now suppose another circle drawn at right-angles to the equator and passing through the two poles. This circle would be called a *meridian*. We now have two circles or lines running round the earth, and by means of these we can describe the position of any place on the earth's surface. Thus, if we know that the place is 200 miles north of the equator and 600 miles west of the meridian, we can point out the position of the place. But as the meridian cuts the equator in two points, it is necessary to select one-half of the meridian for the purpose of measurement east and west. Show this on the globe.

The distance of the place north or south of the equator is called its *latitude*. Its distance east or west of the chosen half of the meridian is called its *longitude*.

(5) Next show that any place can have its meridian, that is, a circle running through it and the poles, and cutting the equator at right-angles. The meridian before referred to, from which longitude is measured, is called the *first meridian*. Different countries have chosen different first meridians. In England we calculate longitude from the meridian of Greenwich. Point to it on the globe and map.

(6) Latitude and longitude are calculated by *degrees*, not by miles. Explain that a circle is divided into 360 parts, each being a degree. Let the children repeat the table of degrees, minutes, etc. So we measure, not by miles, but by *parts of a circle*. If the meridian of a place cuts the equator 20° west of the point where the first meridian cuts the equator, then the longitude of the place is 20° west. Similarly, if the place be north of the equator, and the number of degrees measured on the meridian of the place between the place itself and the equator be 30°, then the latitude is 30° north. Point out the

parallels of latitude, and show how they mark the number of degrees on the *meridians of longitude*. Call for the latitude and longitude of various places, as the Azore Islands, Ceylon, New Zealand, etc. Name various latitudes and longitudes, and ask the children to point them out. (This is the practical part of the lesson, and must be continued till the children show that they have grasped it firmly.)

(7) Illustrate the use of latitude and longitude by referring to the laying of the Atlantic telegraph. In 1865 the cable broke as it was being paid out in mid-ocean, and sank to the bottom, many thousands of feet deep. How were the seamen to mark the place where this happened, so as to be able to find it again if required? They could not mark the water, or set up a post, as if they were on land. They simply took the latitude and longitude of the place, by means of instruments, and a year or two afterwards men returned to the same spot, which they found without any difficulty, and by means of grappling apparatus recovered the lost cable from the depths of the ocean.

32. Give full Notes of a Lesson on "Central America." Draw a map in illustration.

33. Name and describe the rivers which flow into the Indian Ocean and its branches.

34. Describe the Pacific Ocean, its Islands, Straits, surrounding Countries, Currents, and prevailing Winds.

Careful notices of changes in political boundaries, population, and other matters subject to variation, together with articles on recent geographical discoveries, are contained in *Papers for Teachers and Students*, a monthly serial, published by Messrs. Moffatt & Paige.

ASTRONOMY.

(For general description of the earth, *see* "*Pupil Teachers Course*" for First Year.)

DEFINITIONS.

Astronomy is the science which treats of the heavenly bodies, namely, the Sun, the Moon, the Planets, and the Stars; describing their magnitudes, distances, motions, and the laws by which they are governed.

A **Plane**, or **Plane Superficies**, is a surface in which, if any two points are taken, the straight line joining them lies entirely in that surface.

A **Circle** is a plane figure contained by one line, which is called the *Circumference*, and is such that all straight lines drawn from a certain point within the figure to the circumference are equal to one another. This point is called the *Centre* of the circle.

Any straight line drawn from the centre to the circumference is called a **Radius** of the circle. The plural of radius is *radii*. All the radii of a circle are equal to one another.

A **Diameter** of a circle is a straight line drawn through the centre, and terminated both ways by the circumference.

The **Plane of a circle** is an imaginary flat surface supposed to join every part of the circumference with the centre.

Any portion of the circumference of a circle is called an **Arc.**

For the purposes of measurement, the circumference of a circle is supposed to be divided into 360 parts, each of which is called a degree. Each degree is divided into sixty minutes, and each minute into sixty seconds. These are generally ex-

pressed by signs, thus :—54° 3′ 25″ signifies 54 degrees, 3 minutes, 25 seconds.

The terms *degree*, *minute*, *second*, do not express any fixed measurements. The length of each depends on the magnitude of the circle.

The half of a circle is called a **Semicircle.**

A **Globe**, or **Sphere**, is a solid body contained under a single surface, every point in which is equally distant from a point situated within the body, and called the centre.

A Globe, or Sphere, may be supposed to be described by the revolution of a semicircle about its diameter, which remains unmoved.

A **Great Circle** of a sphere is one whose plane passes through the centre of the sphere. A great circle divides the surface of a sphere into two equal parts.

A **Small Circle** is one whose plane does not pass through the centre of the sphere.

When we look towards the sky, it appears to have the form of the inner or concave surface of a large globe or sphere, of which we are placed in the centre. For the purposes of calculation and description, imaginary lines are supposed to be drawn on the surface of the heavens, corresponding in some measure with those supposed to be drawn on the surface of the Earth.

If we imagine the earth's axis to be extended or *produced* both ways till it meets the sky in two opposite points, we shall then have two points in the heavens corresponding with the North and South poles of the Earth. These are called the **North Pole** of the Heavens, and the **South Pole** of the Heavens.

In these northern latitudes we never see the position of the south pole of the heavens, but that of the north pole is always visible. It is situated very near to the Pole Star, which may easily be found on a clear night.

The stars in the sky are arranged in groups supposed to form figures of animals and other well-known objects. These groups of stars are called **Constellations.** One of the most conspicu-

ous of these is the *Great Bear*, which shines in the northern heavens, and is chiefly distinguished by seven bright stars, called *Charles's Wain*, or the *Plough*. The two stars on the right hand side (numbered 6 and 7 in the diagram) are named the *Pointers*, because they point to the pole-star. If we imagine a line to be drawn through them and carried on for some distance, it will pass close to the pole-star (8).

THE GREAT BEAR AND POLE-STAR.

If we observe the stars for some time on a clear night, we shall find that they appear to move round the pole-star, which alone remains fixed in the sky. The others revolve round it in circles. This motion is, however, only *apparent*. It is caused by the rotation of the earth on its axis once in twenty-four hours. It is the earth which really moves from west to east, causing an apparent motion of the sun, the moon, and the stars from east to west.

Let us now imagine a great circle to be drawn round the heavens exactly midway between the north and south pole.

This great circle is called the **Equinoctial.** It corresponds with the equator of the earth. If we suppose the plane of the equator produced so as to cut the sky, it would meet the equinoctial in every point. Hence the equator and the equinoctial are sometimes termed the **Terrestrial Equator** and the **Celestial Equator.**

A parallel series of small circles is supposed to be drawn in the heavens north and south of the equinoctial, and between it and the poles. These are called **Parallels of Declination,** and correspond with the parallels of latitude on the surface of the earth. By means of these the celestial latitude, or **Declination,** of a point in the sky or of a heavenly body may be described. A point is said to be in north or south declination according as it is situated to the north or south of the equinoctial. Distance north or south of this line is measured by degrees, minutes, and seconds, as on the surface of the earth.

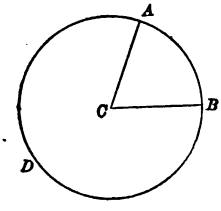
A series of great circles are supposed to be drawn through the poles and round the heavens. These are called **Celestial Meridians,** and correspond with the meridians of longitude on the surface of the earth. By means of these the celestial longitude, or **Right Ascension,** of a point in the sky or of a heavenly body may be described. The measurement is again in degrees, minutes, and seconds, and is reckoned to the east from the first celestial meridian, which crosses the equinoctial at the first point of Aries, or the Vernal Equinox. (*See* pages 100 and 112.)

Thus, if a point in the sky is described as being in right ascension 250° and south declination 35°, we know that it is situated 250 degrees to the east of the first celestial meridian, and 35 degrees to the south of the equinoctial. In this way an observer who is acquainted with the position of these lines on the sky is able to determine the position of the point.

The sun appears to move round a great circle of the heavens in the course of one year. This circle is called the **Ecliptic;** it is properly the path which the earth would appear to take if viewed from the sun, since it is the Earth which moves round the Sun, and not the Sun round the Earth.

Two planes may either coincide with each other, or be parallel to each other, or cut each other at a certain angle.

Angles are measured by the number of degrees in the corresponding arc of a circle drawn with any radius, and having its centre at the point of intersection of the two lines which form the angle. Thus, if A C B be an angle, and A B D be any



circle with centre C, then the angle A C B is measured by the number of degrees, minutes, and seconds in the arc A B. An angle subtending the quarter of a circle is a right angle, and contains 90 degrees ($360° \div 4$).

The plane of the equinoctial is inclined to that of the ecliptic at an angle of $23\frac{1}{2}$ degrees. They cut each other in two opposite points, called the *equinoctial points*, or *equinoxes*.

The **Zodiac** is a belt or girdle of the heavens extending about 9 degrees on each side of the ecliptic. The apparent paths of the sun, the moon, and the planets lie within the Zodiac.

The ecliptic and the zodiac are divided into twelve equal parts, called the **Signs of the Zodiac**, marked by constellations named chiefly after various living beings.

The sun appears to travel through each of these signs in succession, according to the month, and the season of the year.

The names of the twelve signs of the Zodiac are as follows :—

A. **Northern Signs**, situated to the north of the equinoctial.

(1) SPRING SIGNS.

Aries, or the Ram.
Taurus, or the Bull.
Gemini, or the Twins.

(2) SUMMER SIGNS.

Cancer, or the Crab.
Leo, or the Lion.
Virgo, or the Virgin.

B. **Southern Signs.**

(3) AUTUMN SIGNS.

Libra, or the Balance.
Scorpio, or the Scorpion.
Sagittarius, or the Archer.

(4) WINTER SIGNS.

Capricornus, or the Goat.
Aquarius, or the Waterman.
Pisces, or the Fishes.

The following lines will help our readers to remember them :

"The Ram, the Bull, the Heavenly Twins,
And next the Crab, the Lion shines,
The Virgin and the Scales.
The Scorpion, Archer, and He-goat,
The Man that bears the water-pot,
And Fish with glittering tails."

The **Zenith** is the point in the heavens exactly over the head of an observer on the earth's surface.

The **Nadir** is the point in the heavens exactly under the feet of an observer on the earth's surface. It is therefore precisely opposite to the zenith, and is of course invisible to the observer, being hidden from him by the mass of the earth.

The **Sensible,** or visible, **Horizon** is the circle which bounds the view of an observer, where the sky appears to meet the earth or sea.

The **Rational,** or true, **Horizon** is a great circle of the heavens formed by an imaginary plane passing through the centre of the earth parallel to the sensible horizon.

The sensible horizon extends over a radius of only a few miles, more or less, according to the height of the observer

above the ordinary level of the Earth; but the rational horizon divides the sphere of the heavens into two equal parts.

The zenith and nadir are the two poles of the rational horizon at any point on the earth's surface.

THE SOLAR SYSTEM.

If we observe the heavenly bodies for a number of consecutive nights, we shall find that they may be distinguished as belonging to two divisions, namely :—

1. Those which keep the same relative positions with regard to each other. They appear to move round the pole-star from east to west, it is true, but they always remain at exactly the same distance from each other, and form groups or constellations, each of which retains the same form. These are the **Fixed Stars.**

2. Those which change their relative positions with regard to each other, and appear to travel through the signs of the Zodiac, being sometimes in one constellation and sometimes in another. These bodies consist of—

(*a*) The **Moon,** which revolves round the Earth, and

(*b*) The **Planets,** which revolve round the Sun.

The Fixed Stars may be distinguished from the Planets by their twinkling or tremulous light. The planets shine with a steady, unintermittent light.

The former are believed to be suns, each shining by its own light. The latter are dull bodies like the Earth, shining only by light falling on them from the sun.

The **Earth** is one of the planets. It revolves round the sun like the other planets.

The **Sun,** together with the planets and their attendant bodies, make up the Solar System (Lat. *Sol*, the sun).

The fixed stars lie outside of, and at a vast distance from, the solar system, and, as far as we know, have little or no dependence on it.

This System of the Universe is called the **Copernican System,**

because it was given to the world by Nicholas Copernicus, who lived at Thorn, in Prussia, in the 15th century. It is said, however, to have been taught by Pythagoras, a famous Greek philosopher, who lived 500 years before the Christian era. His teaching was not, however, accepted by the ancients, who generally held the views of Ptolemy, of Alexandria in Egypt. This astronomer held that the Earth is the centre of the Universe, and that the Sun, the Moon, the Planets, and the Stars revolve round it as they appear to do in the sky.

These and other erroneous notions on the subject of the heavenly bodies were finally superseded by the Copernican System, which has been confirmed and established on an immovable basis by the observations and calculations of modern astronomers.

I. THE SUN.

The Sun occupies the centre of the Solar System. The Earth and the other Planets revolve round it, each in its separate path or **Orbit** (Lat. *orbis*, a wheel or circle). The Sun is a sphere, or globe, far exceeding in bulk any one of the bodies which receive their light and heat from it. It is nearly 700 times greater than the Earth and all the other planets together.

The diameter of the Sun is 852,600 miles, or nearly one hundred and ten times greater than that of the Earth.

The Sun is supposed to be an immense solid body, whose nature is imperfectly known, surrounded by a gaseous atmosphere heated to an intense degree, and subject to storms of a terrific character. Immense spots often appear on the surface of the sun. Their dark appearance is supposed to be caused by vast gaps in the fiery atmosphere, and the laying bare of the body of the Sun beneath. Sometimes a spot is shaded off into two or more degrees of darkness (surrounding each other), according to the depth to which the luminous atmosphere has been removed in the several portions of the spot. In cases of this kind the dark centre is called the *nucleus;* next come the *umbra* and *penumbra*, and the whole is encircled by the full

brightness, or *photosphere.* Constant changes are going on in each spot, and in each portion of it, both in size and shape. These spots are of various sizes; some have been observed whose diameters must have measured 40 or 50 thousands of miles.

During the last twenty years, through a process called **Spectrum Analysis**, experiments have been carried on by which the light from a heavenly body can be analysed, and the substances which exist in it in a state of incandescence can be determined by the colour of the rays emitted. By means of solar spectra it has been found that Sodium, Iron, Magnesium, Copper, Zinc, Hydrogen, and several other elements are present in the Sun.

The Sun is not exactly spherical; it is an oblate spheroid, flattened at the poles, like the Earth and the other planets.

Observations of the spots on the Sun's disc have shown that it rotates on its axis. Spots have been found to appear on one side of the Sun's surface, to travel gradually across it, and then to disappear on the other side. In this way it has been discovered that the Sun rotates on its axis in a period of 25 days 8 hours, nearly.

The Sun's axis is inclined to the plane of the earth's orbit at an angle of 82° 40′, being thus 7° 20′ out of the perpendicular.

As we have already observed, the sun appears to travel along a path in the sky called the Ecliptic, through the signs of the Zodiac. This is only an apparent motion; it is caused by a real motion of the earth, as one of the planets, in its orbit round the Sun.

II. THE EARTH.

1. FORM, SIZE, POSITION.

Form.—As already explained, the Earth is an Oblate Spheroid, flattened at the poles, like an orange.

Size.—The diameter of the Earth at the Equator is about 7,900 miles. At the poles the diameter is about 26 miles less. The circumference of the Earth is nearly 25,000 miles.

Position.—The Earth's distance from the Sun is about 91,500,000 miles. This is the *mean* distance. The Earth is more distant from the Sun at one part of the year than at another.

2. ROTATION. DAY AND NIGHT.

The earth turns round, or *rotates*, on an imaginary line called its **Axis**, once in every twenty-four hours.

As the Earth is of the form of a sphere, or spheroid, one half of it is turned towards the Sun, while the other half is turned away from it. Hence one half of the Earth is in the light while the other half is in darkness.

If the Earth remained perfectly still, the same one half would always be in the light, and the same other half would always be in darkness. But the Earth rotates on its axis, causing the half of the world which was before in the light to move into the darkness, and the half which was before in the darkness to move into the light.

The time when it is light, is called **Day**; and the time when it is dark, is called **Night.** Day is caused by the shining of the Sun; Night is caused by the withdrawal of the Sun. A person standing on the light side of the Earth can see the sun shining in the sky. But a person standing on the dark side of the Earth cannot see the sun, because it is shining on the other side.

It is always day on one side of the Earth, and it is always night on one side of the Earth; for the Sun never ceases to shine, and he can shine only on one-half of the world at the same time. When it is day on one-half of the Earth, it is night on the other.

If we observe the course of the Sun, we see that he appears to rise in the east in the morning, move gradually round to the south at noon, and then pass slowly on and set in the west at evening time.

This motion of the Sun is not real, but apparent. It is not the Sun which moves, but the Earth, rotating on its axis.

We do not feel the Earth moving, because it moves so steadily

and quietly. There is no shaking, nor jolting, nor noise. When we travel in an express train on a smooth line of railway we are scarcely conscious of any motion of our own, and if we look out of the carriage window the trees, houses, and telegraph posts seem flying past us. They appear to be moving from us, while we seem to be remaining in the same place. If we are travelling from west to east, the trees and other objects seem flying the other way, from east to west. Similarly the real rotatory motion of the Earth from west to east occasions an apparent motion of the sun in the contrary direction, from east to west.

If the Earth's axis were exactly perpendicular to the plane of its orbit, there would be equal day and night (12 hours of each) on every part of the Earth's surface all the year round. But the axis is inclined somewhat from the perpendicular, and this deviation from the vertical causes the days to be longer in summer and shorter in winter, and the nights to be shorter in summer and longer in winter, as is explained in the chapter which treats of Seasons and their causes.

Day and Night do not come on all at once exactly at sunrise and sunset. There are two short periods in every twenty-four hours during which Day and Night are gradually passing one into the other. This is during the times called **Twilight**. In the morning twilight, a short interval before sunrise, night is gradually passing away, and the Morning Star (Hesperus) announces the approach of the Sun. In the evening twilight, another short interval after sunset, the light is gradually fading away into darkness, and the Evening Star (Lucifer) tells us that night is at hand.

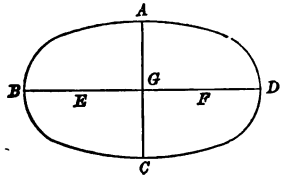
It is the rotation of the Earth on its axis which causes our planet to take the form of an oblate spheroid. The parts of the Earth's surface near to the equator rotate in larger circles than those near the poles. Hence, having a larger distance to travel in the same time, the parts near the equator move with a greater velocity than those near the poles. Thus the greater centrifugal force (or tendency to fly from the centre of rotation) at the

equator causes the equatorial portions of the Earth's surface to bulge out, while the polar regions are in like manner depressed. The same remarks apply to the planets and other bodies which rotate on their axes.

3. ORBIT. ELLIPSE.

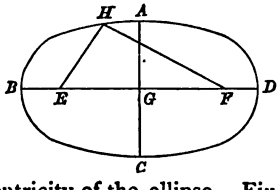
The path in which the Earth moves round the Sun is not exactly a circle. It is an **ellipse**. The Earth, and each of the other planets revolves round the Sun in elliptical orbits.

An ellipse is a figure of an oval shape, formed by cutting a cone by a plane which cuts all sides but is not parallel to the base. Its length is greater than its breadth. A B C D is an ellipse, of which the length, or longer diameter, is B D, and the



breadth, or shorter diameter, is A C. B D is usually called the *conjugate axis* and A C the *transverse axis*. An ellipse is regarded as having two *foci*, or centres. In this respect it differs from a circle, which has only one. If E and F be the foci, then G E or G F, the distance of each focus from the point in which the axes intersect, is called the *eccentricity* of the ellipse. The greater the eccentricity of an ellipse, the greater is its deviation from a circle.

An ellipse may be drawn in the following manner. Take E F

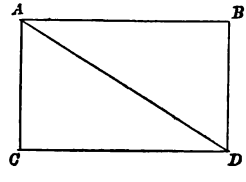


double of the eccentricity of the ellipse. Fix a pin in each of

the points E, F. Then take a string of the length of the transverse axis, and fasten its ends on the two pins E and F. Now stretch the string to its full extent, so that it reaches to a point in the required curve at H; and by moving a pencil round within the string, keeping the latter always stretched out, the ellipse will be traced.

Each of the planets, including the earth, moves in an orbit which is an ellipse of only small eccentricity. Some of their orbits are more eccentric than others, but not one of them differs very widely from a circle. The Sun is situated in one of the foci of each ellipse representing the orbit of a planet. Thus, if a planet move in the orbit A B C D, the Sun is situated at E, or at F. It will easily be seen that a planet is nearer to the Sun during one part of its revolution than at another. For, supposing the Sun to be situated at E, the distance of the planet when at D is greater than its distance at B. In the former case the distance is E D, and in the latter E B. The point on a planet's orbit where it is at its greatest distance from the sun is termed the **Aphelion** (Gr. *apo*, from; *helios*, the Sun) of the planet. The point where it is at its least distance is called the **Perihelion** (Gr. *peri*, around; *helios*, the Sun) of the planet. In the last figure the point D represents the aphelion, and B the perihelion of the planet revolving round the Sun at E in an orbit A B C D.

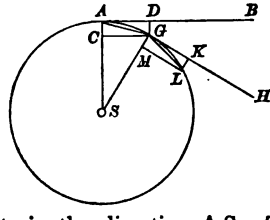
The revolution of the Earth round the Sun is caused by the combined influence of two distinct forces. It is a well-known principle in mechanics, that if a body be impelled by two forces acting in two different, but not opposite, directions, the body will move in a path situated between the two directions. Thus, if a body at A be impelled at the same time by a force acting in the direction A B, and another acting in the direction A C, it



will move in neither of those directions, but in a path A D lying between A B and A C. If the force acting along A B be greater than the force acting along A C (as indicated by the line A B being longer than the line A C), then the path A D will be nearer to A B than to A C, and *vice versa.*

The Earth is acted upon by two forces constantly in operation. The attraction of the Sun draws it towards the centre of the solar system. Besides this, the earth has a tendency to fly off in a straight line in a direction at right angles to a line drawn from it to the Sun. We know not by what exact means this impulse was originally given to it, but must simply suppose that it was imparted by the Almighty Creator of all things.

Let us suppose the Sun to be at S, and the Earth at A, and that a force is acting upon it in the direction A B. The attrac-



tion of the Sun acts in the direction A S. The Earth will not move in either of the directions A B, A S, but in a direction lying between the two. Consequently, at the end of a given time the Earth will be found at G.

The attraction of the Sun will now act in the direction G S, while the Earth has again a tendency to move in the direction G H, at right angles to G S. It will again move in an intermediate direction, and at the end of another similar period of time will be found at L. A, G, L are points on a circle, and any number of intermediate points in it may be found by making rectangles similar to A C G D, G M L K, but smaller.

The explanation given above will impart a general knowledge of a subject which cannot be clearly understood without the aid of mechanics. It may be further illustrated by considering a

stone tied to the end of a string and twirled round in a boy's hand. Here the stone is acted upon by two forces. The string pulls the stone towards the boy's hand, while the direct impulse acting on the stone tends to make it fly off in a line at right angles to the string; indeed, if the boy were to let go the string, the stone would actually fly off in that direction. Here there are two forces; one is the **centripetal force** (Lat. *peto*, I seek), acting *towards* the centre, and the **centrifugal force** (Lat. *fugio*, I flee), acting *away from* the centre. The stone moves in a circle, in a direction between the lines of the two forces.

Thus the Earth moves round the Sun in an orbit which is nearly circular. Why it moves in an ellipse which brings it nearer to the Sun in one part of its course than another, cannot be understood without considerable mathematical knowledge. The following explanation will be sufficient here. Sometimes the attraction of the Sun overcomes the centrifugal force to a certain extent. This causes the Earth to approach nearer to the Sun, and at the same time increases its velocity. This increased velocity, on the other hand, also increases the centrifugal force, just as the faster the stone is whirled round on the string, the greater is its tendency to fly off (in a tangent). This increase of the centrifugal force counteracts the augmented attraction, and the Earth is borne back again to its former distance from the Sun.

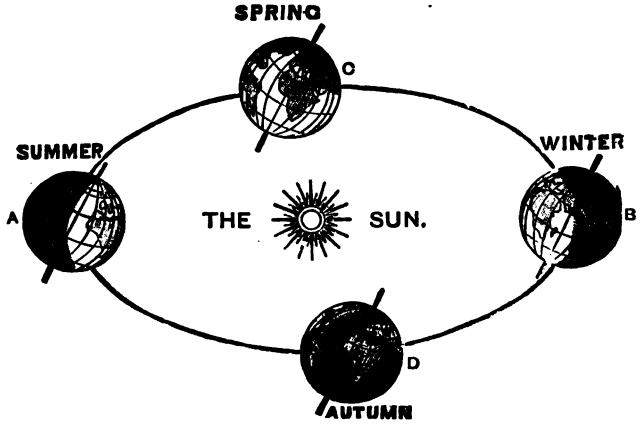
4. SEASONS.

The Earth moves round the Sun in the space of a year. If the axis of the Earth were perpendicular to the plane of its orbit, it is evident that the length of days and nights would be equal all the year round on every part of the Earth's surface. For then every part of the Earth's surface would, by the rotation of our planet on its axis, be turned towards the Sun for twelve hours, and away from the Sun for twelve hours, during each day.

But the axis of the Earth is inclined about $23\frac{1}{2}°$ out of the perpendicular. In other words, the plane of the Earth's equator is inclined to the plane of the equinoctial at an angle of about

$23\frac{1}{2}°$. The axis of the Earth continues parallel to itself during the whole of each annual revolution; that is to say, it is inclined to the plane of the Earth's orbit at the same angle during the whole year.

The consequences of this inclination of the Earth's axis will be seen from the accompanying diagram.



THE SEASONS.

When the Earth is at A, the northern half is, by reason of the inclination of the axis, turned towards the Sun, while the southern half is turned away from the Sun. Hence, as the Earth revolves on its axis, the portions of the Earth's surface near the North Pole remain in the light, and those near the South Pole remain in darkness. When the Earth is at A, it is summer in the northern hemisphere, and winter in the southern hemisphere. At this part of the year the Sun never sets near the North Pole, and never rises near the South Pole. Between the north polar and equatorial regions the days are long and the nights are short, because a larger part of the northern

hemisphere is in the light than in the darkness. For a contrary reason, between the south polar and equatorial regions the days are short and the nights are long.

When the Earth arrives at B, a complete change has taken place, though the axis of the Earth still preserves the same inclination to the plane of its orbit. Now the northern hemisphere is turned away from the Sun, while the southern hemisphere is turned towards it. This is at the time of our winter, when the Sun never rises on the North Pole and never sets on the South Pole; when the days are short and the nights are long in the North Temperate regions, while the days are long and the nights are short in the South Temperate regions.

When the Earth is at C and at D, the North and South poles are neither inclined towards nor from the Sun. In these positions we have the northern Spring and Autumn, when the days and nights are equal all over the Earth.

Let us suppose the Earth to commence its annual revolution at C. The Sun is then entering Aries; it is the 21st of March, the time of the **Vernal Equinox**, when the days and nights are equal throughout the world. The Earth travels towards A, and the Sun passes through Aries, Taurus, and Gemini. When the Sun arrives at Cancer, the Earth has moved to A. The North Polar regions have become more and more turned towards the Sun, and the northern days gradually lengthened. The Earth arrives at A on June 21st, the time of our longest day, or **Summer Solstice.** While the Earth moves from A to D, the Sun travels through Cancer, Leo, and Virgo. When he arrives at Libra, the Earth is at D. This is at the time of the **Autumnal Equinox,** Sept. 22nd, when the days and nights are again equal throughout the world. As the Earth journeys from D to B, the Sun passes through Libra, Scorpio, and Sagittarius. When he arrives at Capricorn, the Earth is at B. The northern days have been gradually shortening, while the southern days have been lengthening in the same proportion. The earth arrives at B on December 22nd, which is the time of **Winter Solstice.** Then the northern days are shortest, and the southern days

are longest. The Earth pursues its course from B to C, while the Sun passes through Capricorn, Aquarius, and Pisces; till at C it again enters the sign Aries.

Thus the inclination of the Earth's Axis gives rise to four seasons, which take place at opposite times in the Northern and Southern Hemispheres.

In our Spring the days are lengthening, the northern parts of the Earth are becoming more and more inclined towards the Sun, which consequently shines more and more overhead.

In our Summer, the days have reached their greatest length, and begin to get shorter.

In our Autumn, the days gradually become shorter, the northern parts of the Earth are becoming less and less inclined towards the Sun, which consequently shines less and less overhead.

In our Winter, the days have reached their least length, and begin to get longer.

It will be evident from the diagram that the Equatorial regions of the Earth are always turned towards the Sun. During the whole year exactly one-half of the equator is in the light, and one-half is in darkness. Hence at the equator the days and nights are of equal length all the year round. On the Equator itself there is no change of seasons. On March 21st the Sun is vertical at the Equator. Then he gradually rises higher in the northern hemisphere, till on June 21st he is vertical at the Tropic of Cancer. He then gradually sinks towards the south, and on September 22nd he is again vertical at the Equator. During the next quarter he sinks gradually in the southern hemisphere, till on December 22nd he is vertical at the Tropic of Capricorn. Then he rises again towards the north, and on March 21st he is once more vertical at the Equator.

The times at which the Sun is vertical at the equator are called the Equinoxes (Lat. *aequus*, equal; *nox*, night), because the nights are then equal all over the earth. There are two equinoxes—the Vernal Equinox, March 21st, and the Autumnal Equinox, September 22nd.

The times at which the Sun is vertical at the tropics are called the **Solstices** (Lat. *sol*, the Sun; *sto*, I stand), because then the Sun appears to stop in its northward or southward course, before turning in the opposite direction. There are two Solstices—the Summer Solstice, June 21st, when the Sun has reached his most northerly limit, and is vertical at the Tropic of Cancer; and the Winter Solstice, December 22nd, when the Sun has reached his most southerly limit, and is vertical at the Tropic of Capricorn.

The **Tropics** (Gr. *trepo*, I turn) are so called because they mark the boundaries of the Sun's path, and the positions which it attains before turning towards the north or towards the south. The distance of the tropics from the equator, $23\frac{1}{2}°$, necessarily coincides with the deviation of the Earth's axis from a perpendicular to the plane of its orbit.

The greater heat of our summer is not caused by the earth being then at a less distance from the Sun than during winter, for we are actually further from the Sun in summer than in winter. The Earth's orbit is, as we have already seen, an ellipse, of which the Sun occupies one of the foci. At Midsummer the Earth is in aphelion, or the greatest distance from the Sun, while on December 22nd it is in perihelion, or the least distance from the Sun. Thus we are actually more than three millions of miles further from the Sun at Midsummer than at Midwinter. This causes the Sun to appear somewhat larger in the middle of winter than in the middle of summer. The Sun's apparent diameter on December 22nd is 32′ 47″, while on June 21st it is only 31′ 40″.

The greater heat of summer and the less heat of winter are due to two causes.

1. In summer the Sun rises to a greater height above the horizon, and therefore his rays fall more perpendicularly upon the northern part of the Earth than in the winter.

2. In summer the days are very long, and the nights short; hence the Earth and the air are heated by the Sun during the day more than they are cooled in the night. From this cause

there is an *accumulation of heat*, and the Earth becomes warmer day after day. This process continues for some time after the longest day; hence the greatest heat of summer is not arrived at till some weeks after the summer solstice, when the Sun is at his highest elevation in the northern hemisphere.

An attentive examination of the diagram will show that during the Earth's progress from D to C, the rotation of its axis will never turn the north pole towards the Sun, nor the south pole away from it. On the other hand, during the Earth's progress from C to D the rotation of its axis will never turn the north pole away from the Sun, nor the south pole towards it. Hence at the poles the year consists of one long day of six months' duration, and one long night also of six months' duration.

At the equator the days and nights are of equal length all the year round. At the poles they are each six months in length. From the equator to the poles the inequality between the lengths of the days and nights in summer and winter gradually increases in proportion to the latitude. The greater the latitude, the longer are the days in summer and the nights in winter, and *vice versa*.

5. ATMOSPHERE.

The Earth is surrounded by an envelope composed of a thin fluid or gaseous substance called air. The whole body of air surrounding the Earth is termed the **Atmosphere** (Gr. *atmos*, vapour; *sphaira*, a sphere).

Height. Various experiments have been tried, with a view of ascertaining the height to which the atmosphere surrounds the Earth. Many estimates have been made, varying from 45 to more than 200 miles; but no reliable result has yet been arrived at.

Density. As air is very elastic, it yields easily to pressure. Hence the lower strata, being pressed down by those above, are

much denser than the upper strata. Hence the density, and consequently the weight, of any portion of the atmosphere depends chiefly on its height above the surface of the earth. Thus, the height of a mountain may be ascertained by means of a barometer, or instrument for measuring the weight of the atmosphere.

Weight. The weight of the air can easily be discovered by means of a hollow globe, so arranged that the air can be exhausted from it with the aid of an air-pump. If the globe be weighed before and after the air has been exhausted, the difference of weights will give the weight of the air required to fill the globe, whose cubic contents are supposed to be known. Thus, the weight of 100 cubic inches of dry air at 60° F. when the barometer is at 30 inches, has been found to be 31·074 grains. When the temperature is greater, or the mercury in the barometer lower, the weight is proportionately less.

Pressure. According to the laws of fluids, the air presses with an equal weight in all directions on bodies immersed in it, according to the height of the fluid above any given body. The pressure of the atmosphere is of course greater at the surface of the earth than at any higher point, and it is greater still in a mine or pit. In the barometer at the surface of the earth a column of mercury about 30 inches in height is supported by the pressure of the atmosphere. A column of mercury 30 inches in height and having a horizontal section of 1 square inch, weighs nearly 15lbs. Hence the pressure of the atmosphere at the surface of the earth is equal to nearly 15lbs. (14·73 lbs.) on every square inch. The actual pressure, however, varies according to the differing conditions of the atmosphere, and this constant change causes the mercury to rise and fall in the barometer.

Composition. The air is composed mainly of two gases, oxygen and nitrogen, with a small quantity of carbonic acid. The following table gives the approximate proportions of each of these substances, by volume and by weight, taking 100 parts of air in each case :—

	Volume.	Weight.
Nitrogen.	79·02.	76·84.
Oxygen.	20·94.	23·10.
Carbonic Acid.	·04.	·06.

Air is seldom or never found quite dry and pure; it usually holds a certain amount of vapour, smoke, and other impurities.

6. DIVISIONS OF TIME.

Sidereal Day. The rotation of the Earth is always performed in exactly the same time, 23 hours, 56 minutes, 4 seconds, nearly. This is the time during which any meridian on the Earth's surface will revolve from its position opposite to any fixed star to the same place again. This space of time is called a sidereal day. Every sidereal day is of exactly the same length.

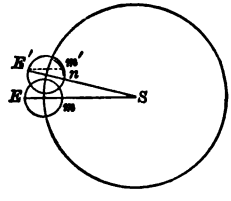
Solar Day. The period during which any meridian on the Earth's surface will revolve from its position opposite to the Sun to the same place again, is termed a solar day.

The solar day is different in length from the sidereal day, and varies in different parts of the year, according to the position of the Earth in its orbit.

The distance of the fixed stars from us is so great that the diameter of the earth's orbit, though more than 180 millions of miles, is but a point in comparison; and therefore any meridian on the Earth's surface will revolve from a fixed star to that star again in exactly the same time, just as if the Earth had a diurnal motion only, and remained always in the same part of its orbit.

But with respect to the Sun, as the Earth advances nearly one degree eastward in its orbit in the same time that it turns eastward on its axis, it must make more than a complete rotation before it can come into the same position with regard to the Sun as it occupied the day before. In the same way, when the hands of a clock set off together at twelve o'clock, the minute hand must travel more than a whole circle before it will overtake the hour hand; that is, before they will be again in the same relative position.

Thus, the solar day is longer than the sidereal day by about one 360th part of a sidereal day, or about 4 minutes.



Let S represent the centre of the Sun, and E the Earth moving round the sun in an orbit represented by the circle. Let *m* be a point on the Earth's surface opposite to the Sun. Now the Earth revolves round the Sun and also rotates on its axis. When the Earth has arrived in the position E′, the point *m* has moved to *m′*, which is the exact position which it occupied before with respect to the stars. But it is now in a different position with respect to the Sun, and it has to be carried on by the rotary motion of the Earth to *n*, before it again arrives opposite to the Sun.

Mean Solar Day. Solar days, unlike sidereal days, are not all of the same length. The difference depends on two causes.

1. The Earth does not always move round the Sun with the same velocity. When it is near perihelion it moves faster than when near aphelion, as we have already explained. Hence the space represented by *m′n* is greater at one part of the year than at another, and consequently the difference between the sidereal day and the solar day is a variable quantity.

2. The axis of the Earth not being perpendicular to the plane of its orbit, the plane of the equator does not coincide with that of the ecliptic. Now the Sun's apparent annual motion is not in the equinoctial but in the ecliptic; hence his apparent diurnal motion is not always parallel to the equinoctial. This causes a difference between the corresponding lengths on the two great circles of the heavens The subject

is too complicated to be dealt with here, and cannot be well understood without the aid of globes.

The average length of a solar day is 24 hours. This is called the **Mean Solar Day.**

Clocks are regulated on the basis of the Mean Solar Day. Sun-dials are dependent on the apparent motion of the Sun itself; hence they exhibit the variations of the solar day as it differs in length at different times in the year. Clocks and sun-dials generally mark somewhat different points of time; they are only together four times in the year—on Dec. 24, April 15, June 15, and Sept. 21.

Equation of Time. Tables have been drawn up marking the difference between Solar time (as shown on the sun-dial) and Mean Solar time (as shown by clocks and watches) at any date in the year. This adjustment of the two systems is called the equation of time.

Month. In the chapter on the Moon we explain the difference between the periodical (or sidereal) month, and the synodical (or lunar) month. These, as will be easily seen, are analogous to the sidereal and solar days.

There is also the **Calendar Month,** which is an arbitrary division of time, by which the year is divided into 12 unequal portions called Months, and named January, February, etc.

Year. The division of time into years is based on the revolution of the Earth round the Sun, and the succession of seasons resulting therefrom.

The **Astronomical Year,** or **Equinoctial,** or **Tropical** year is the period of time in which the Earth performs a revolution round the sun. This period is 365 days, 5 hours, 48 minutes, 49·7 seconds.

The **Calendar Year,** or **Common Year,** consists of 365 days. This is less than the true year by nearly six hours.

The true period of the Earth's revolution was unknown in ancient times. Julius Cæsar fixed the length of the year at 365 days, 6 hours. In order to arrange for the six additional hours in each year, he introduced an extra day every fourth

year. Thus, each fourth year, or Leap Year, was made to consist of 366 days. From him it was called the Julian Year.

The Romans inserted the extra or intercalary day between the 24th and 25th of February. In their calendar, the 24th of February was called sextum calendas Martias (being their 6th day of March), or the 6th of the Calends of March; hence the intercalated day was termed *bis sextum calendas Martias*, or the *second* sixth of the calends of March, and thus the year of intercalation received the name of **Bissextile**, which it has retained ever since.

Bissextile, or **Leap Year**, may be known by dividing the date of the year by 4; if there be no remainder, it is Leap Year. If there be any remainder, it is not Leap Year. The remainder indicates the number of the year after the previous Leap Year.

The addition of the extra day did not effect a perfect adjustment of the year to the actual period of the earth's revolution. It occasioned an error of about 11 minutes and 11 seconds every year, or of a whole day in about 130 years. Nevertheless, the Julian year continued in general use till 1582, when Pope Gregory XIII. undertook to rectify the error, which by that time amounted to 10 days. He commanded the ten days between the 4th and 15th of October, 1582, to be suppressed, so that the 5th day of that month was called the 15th. This alteration was accepted through the greater part of Europe, and the regulated method of computation was called the **Gregorian Year**, or **New Style**. It was not admitted into our calendars till 1752, when the error amounted to nearly 11 days, which were taken from the month of September by calling the 3rd of that month the 14th. The change was not effected in England without much senseless opposition.

According to the present arrangement, the years 1800 and 1900 are reckoned as common years, having only 365 days in each; and every four hundredth year afterwards will be a common year also. By this mode of reckoning the remaining error will not amount to a single day in less than 5,000 years.

In England, the beginning of the year was changed from the

25th of March to 1st of January. Thus the succeeding months of January, February, and March, up to the 24th, which would, by the Old Style, have been reckoned part of the year 1752, were accounted as the first three months of 1753. Hence we sometimes see such a date as Feb. 10th, 1774–5, that is, according to the Old Style it was 1774, but according to the New Style it is 1775, because now the year begins at a different date.

III. THE MOON.

The Moon is a satellite (Lat., *satelles*, a life-guard) or attendant of the earth, round which she revolves in the period of a month. She shines, not by her own light, but by light thrown on her from the Sun and reflected.

Size. The diameter of the moon is about 2,160 miles. Her apparent diameter varies from 28¾′ to 33½′. She appears largest when on the meridian of any place, and smallest when near the horizon, being about 3,000 miles nearer to an observer at the former position than at the latter. The diameter of the Moon is about one-fourth of that of the Earth; her bulk about one-forty-ninth; and her mass about one-eighty-eighth (the density of the Moon being less than that of the Earth).

Distance from the Earth. The mean distance of the Moon from the Earth is about 238,000 miles; but as she revolves round the Earth in an elliptical orbit, there is a difference of about 50,000 miles between her greatest and least distances from us.

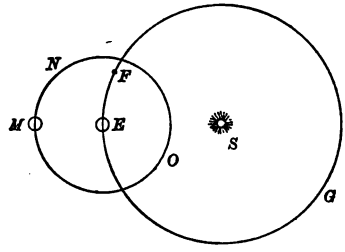
Rotation. The Moon rotates on her axis in precisely the same period that she takes to perform one revolution round the Earth, 27 d. 7 h. 43 m. Hence she always presents the same hemisphere towards us. We never see the other side of the Moon.

Revolution. The exact time in which the Moon performs one revolution round the Earth is, as we have already stated, 27 d. 7 h. 43 m. This is called the **Periodical Month**; it is the time in which the moon revolves from one point of the heavens to the same point again. If, however, we observe the

length of time which elapses between one New Moon and the next, we find it to be 29 d. 12 h. 44 m. This is called the **Synodical Month.**

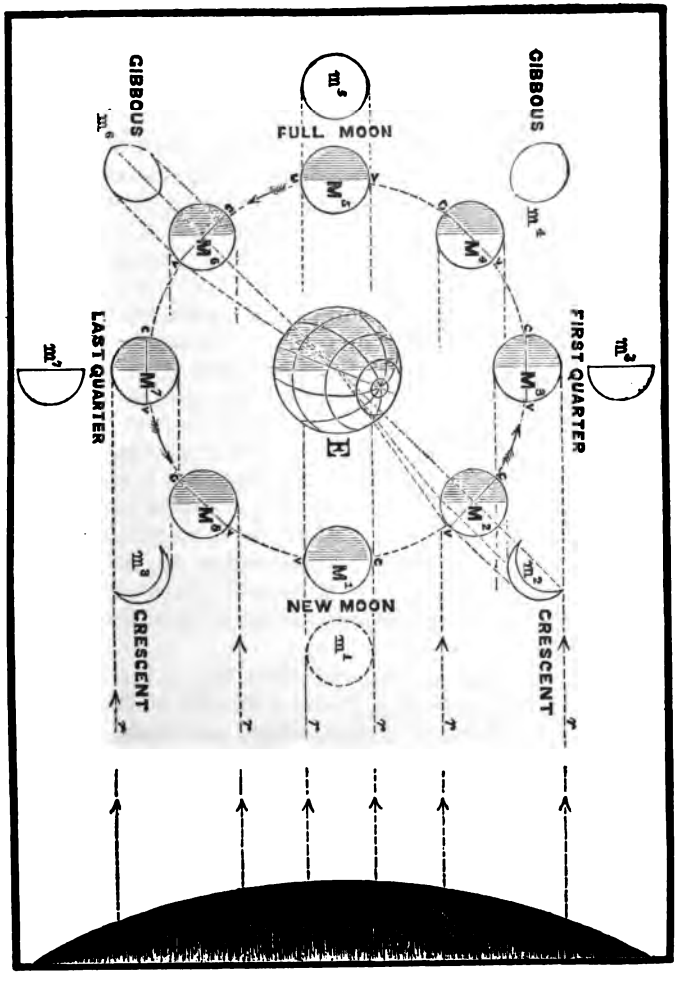
The difference between the two periods is occasioned by the earth's annual motion in its orbit. It may be illustrated by the hands of a watch. They are together at 12 o'clock; but at the end of an hour, though the minute hand has completed a revolution, and arrived at the point whence it started, it does not again coincide with the hour hand. For during this time the latter has advanced the twelfth part of its revolution; and the minute hand, in order to overtake it, has to travel during an additional period of somewhat more than five minutes.

Now, applying this to the Earth and the Moon; suppose S to be the Sun, E the Earth (revolving in its orbit E F G), and M the Moon (revolving in her orbit M N O). If the Earth had no motion, the Moon would move round its orbit into the position M again in 27 d. 7 h. 43 m., and then the Moon,



the Earth, and the Sun would be again in the same relative positions as before. But while the Moon is performing her revolution, the Earth has passed through a twelfth part of its orbit, and has arrived at F, attended by its satellite, which has now to describe a further distance before the three bodies can again be in a line.

Phases. If the Moon were a luminous body, she would always shine with a full orb, like the Sun. But as she only shines by light borrowed from the Sun, one-half of her surface


FULL MOON
GIBBOUS
GIBBOUS
FIRST QUARTER
LAST QUARTER
NEW MOON
CRESCENT
CRESCENT
E

is always dark, and one-half light, like that of the Earth. We generally see only a portion of the illuminated surface of the Moon, which presents to us a variety of appearances, or phases, according to the position she is in with respect to the Earth and the Sun.

The Sun always enlightens one-half of the Moon, M; and its whole enlightened hemisphere, or a part of it, or none at all, is seen by us, according to her different positions in her orbit with respect to the Earth, for only those parts of the enlightened half of the moon are visible on the earth, which are cut off by, and lie within, the orbit.

When the Moon is at M^1, no part of its enlightened side is visible to the Earth, since it is all turned away from us and towards the Sun. It is then the time of **New Moon**, when, the Moon being in a line between the Sun and the Earth, they are said to be in *conjunction*.

When the Moon has travelled to M^2, a small part of her illuminated hemisphere is within her orbit, and to a spectator on the Earth's surface she appears in the form of a **crescent**, with two horns; hence she is said to be horned. At M^3 one-half of the enlightened hemisphere is visible, and the Moon is said to be in **Quadrature.** At M^4 three-fourths of the enlightened part is visible to the Earth, and the Moon is then said to be **Gibbous.**

At M^5 the whole of the enlightened face of the Moon is turned towards the Earth. This is at the time of **Full Moon**, when, the Earth being between the Sun and Moon, they are said to be in *opposition*.

In travelling from M^5, through M^6, M^7, and M^8, to M^1, the Moon exhibits the same phases in reverse order, gradually changing from Full Moon to New Moon; that is, to no visible Moon at all.

The horns of the Moon before conjunction, or New Moon, are turned to the east; after conjunction, they are turned to the west. They are always turned from the Sun.

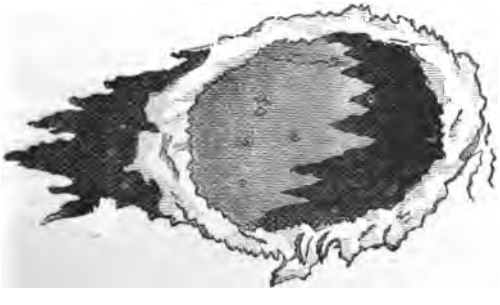
As the length of a day and night on the surface of the Moon

is equal to more than twenty-nine of ours, the Moon has only about twelve days and one-third in the space of one of our years.

The hemisphere of the Moon which is turned towards the Earth is never in darkness, for any portion of it which is turned away from the Sun is illuminated by light reflected on it from the Earth. As the Moon shines on the Earth, so the Earth shines on the Moon. To an observer on the surface of the Moon the Earth presents all the same phases which the Moon does to us, changing from new to crescent, full, and gibbous states. To an inhabitant of the Moon the Earth would appear about thirteen times as large as the Moon appears to us. When it is New Moon to us, it would be Full Earth to him, and *vice versa.*

When the Moon appears as a narrow crescent, we sometimes see the other part of her disc shining with a faint light. This light is caused by the Earth shining on the dark hemisphere of the Moon ; it is in reality Earth-shine.

Physical Features. By means of powerful telescopes, the surface of the Moon has been observed with considerable accuracy. She appears to have either no atmosphere at all, or one of extreme rarity. No signs of clouds, of water, of cultivation, of dwellings, or of living beings, have been found. The surface



A LUNAR MOUNTAIN, WITH ITS SHADOWS.

of the Moon appears to be one unbroken scene of desolation. Vast craters of extinct volcanoes form one of the most remarkable features. One of these, which has been named Copernicus, is said to measure in depth from the top of the wall more than 11,000 feet, while the wall itself rises about half a mile above the ordinary surface of the Moon. This vast crater measures about forty miles across, and it is surrounded by many others of smaller dimensions. No active volcano has been discovered in the Moon.

Lunar mountains and mountain-chains are of huge dimensions. Some of them have been measured by means of the shadows which they cast on the surface of the Moon. A mountain called Dörfell is said to attain a height of more than 26,500 feet. As the Moon is much smaller than the Earth, this is a much greater elevation than any on the surface of our planet, in proportion to the sizes of the two bodies. Thirty-nine mountains higher than Mont Blanc have been measured on the surface of the Moon. This is on only one hemisphere, for it should be remembered that one-half of the Moon is never seen by the eyes of a terrestrial observer.

IV. ECLIPSES.

A. OF THE MOON.

When an opaque body is exposed to the light of the sun, or of any other luminous centre, it casts a shadow in a direction opposite to that from which the light proceeds.

The Earth, being a body of this kind, casts a very large shadow in the direction opposite to the Sun. Whenever the Moon, in its revolution round the Earth, passes through this shadow, its disc becomes darkened, and it is said to be in Eclipse.

It is evident that an Eclipse of the Moon can only happen when the Earth is exactly between the Sun and the Moon ; that is, when the Moon is in opposition, at the time of Full Moon.

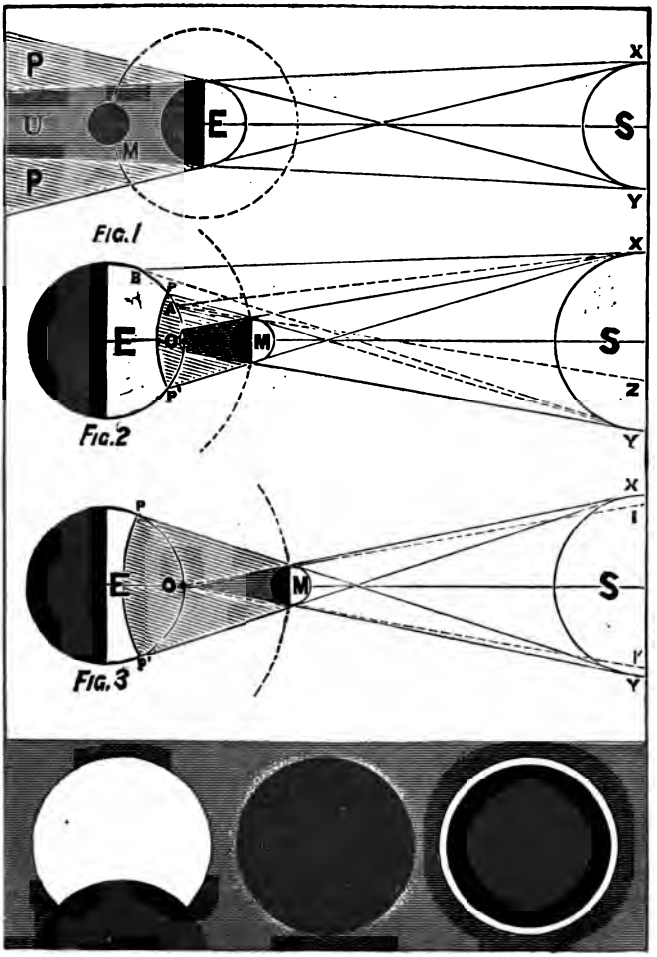


FIG. 4 FIG. 5 FIG. 6

ECLIPSES.

In the diagram (fig. 1, p. 127) S represents the Sun, E the Earth. The dark frustrum of a cone represents the shadow of the Earth. When the Moon arrives at M, at the time of Full Moon, if it passes through this conical shadow it suffers eclipse.

At first sight it would appear that the Moon would be eclipsed every month at the time of Full Moon. But the plane of the Moon's orbit does not coincide with that of the Earth, but is inclined to it at an angle of rather more than 5°. Hence, unless the Full Moon happens in or near one of the two Nodes, or points in which the two orbits intersect each other, she will pass above or below the shadow of the Earth, in either of which cases there will be no eclipse.

When the Moon's disc is entirely immersed in the shadow of the Earth, the eclipse is total; when only a portion of the Moon's surface passes through the shadow, the eclipse is only partial.

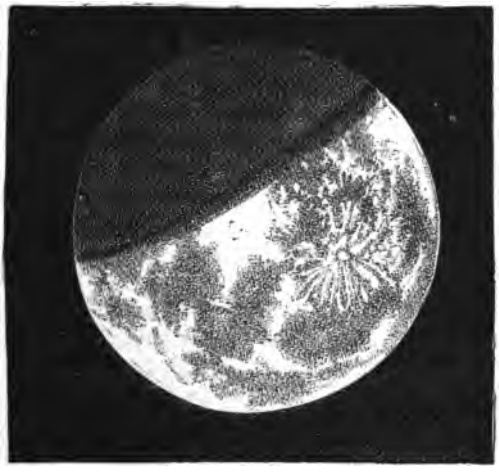
If the Moon when at the full be more than 12° from the node, there can be no eclipse; when she is within that distance, there will be a **partial** or **total eclipse**, according as a part or the whole of her disc falls within the Earth's shadow. If the eclipse happen when the Moon is exactly in the node, it is called a **central eclipse.**

The duration of an eclipse coincides with the time in which the Moon passes through the conical shadow of the Earth. The shadow of the Earth, where the Moon passes through it, is much wider than the diameter of the Moon, and therefore a lunar eclipse lasts sometimes for three, four, or even five hours. The duration of a total or partial eclipse of the Moon varies with her distance from the earth. According as the Moon is nearer to or farther from the Earth, the eclipse will be of greater or less duration, since the shadow, being conical, becomes more and more narrow as it recedes from the Earth.

It will be observed that outside the dark conical shadow marked U there is a lighter shadow in which the sun's light is only partially intercepted. The latter is marked P in the diagram. The darker shadow is called the **Umbra**, and the lighter

the **Penumbra.** When an eclipse takes place, the Moon first enters the Penumbra, then passes through the Umbra, and, after traversing the Penumbra on the other side, finally emerges into the sunlight. The total eclipse of the moon continues only as long as the latter is completely immersed in the Umbra.

Astronomers, knowing the exact distances of the Sun and



A PARTIAL ECLIPSE OF THE MOON, AS SEEN THROUGH A TELESCOPE.

Moon from the Earth at any given time, the size and shape of each of these bodies, and the movements of the Earth and the Moon, are able to calculate the times and conditions of lunar eclipses with the greatest accuracy for any number of years in advance.

B. OF THE SUN.

An eclipse of the Sun is caused by the Moon passing between the Sun and the Earth, and thus intercepting the light coming to us from the centre of the Solar System.

An eclipse of the Sun can happen only at the time of New Moon, when the latter is in conjunction, the Moon being between the Earth and the Sun.

For reasons already explained, an eclipse of the Sun can only take place when the Moon is on or near one of the nodes. When New Moon happens in other parts of her orbit, she passes either above or below the disc of the Sun, and therefore does not intercept any of the solar light coming to us.

Let S (figure 2, p. 127) be the Sun, E the Earth, and M the Moon, at the time of conjunction. The conical shadow of the Moon falls upon the Earth over a space at O. To a spectator situated within this space the whole of the Sun's disc will be obscured; and to him the eclipse will be total. To an observer placed between P and P', but outside the dark space at O, only a part of the Sun's disc will be obscured; and to him the eclipse will be partial. Observers further north than P, or further south than P', would see no eclipse at all.

In the above diagram we have supposed the Moon to be at her least distance from the Earth. In this position the point, or apex, of the cone would extend further than the surface of the Earth, if it were not intercepted by the substance of our globe. Thus, a part of the surface of the Earth, lying within the dark cone, is completely obscured, and the eclipse is total throughout this darkened circle. A total eclipse of the Sun is represented in figure 5, and a partial eclipse in figure 4, p. 127.

In figure 3, p. 127, we suppose the Moon to be at her greatest distance from the Earth at the time of the eclipse. The apex of the conical shadow lies between the Moon and the Earth, and does not quite touch the latter. To an observer at O there will be an Annular Eclipse, in which a ring of light appears round the moon, as in figure 6. To an observer north or south of O, but between P and P', the eclipse will be partial. Further north than P, and further south than P', there will be no eclipse at all.

A total or annular eclipse of the Sun at any particular place is a very rare occurrence. Either of these phenomena is

visible over only a very small portion of the earth's surface, and only for a very few minutes at a time.

V. THE PLANETS.

The Solar System consists of the Sun, which occupies the centre, a number of planets which revolve round it, various satellites or minor bodies which revolve round the planets, and comets.

The term Planet is derived from the Greek word *planetes*, a wanderer. Planets were so called from their appearing to wander about among the fixed stars, and not keeping the same relative positions with respect to each other and to the other heavenly bodies.

The number of planets known to us is eight; namely, Mercury, Venus, the Earth, Mars, Jupiter, Saturn, Uranus, and Neptune, besides the asteroids or planetoids, small planetary bodies having their orbits between those of Mars and Jupiter. Only six of these, namely, Mercury, Venus, the Earth, Mars, Jupiter, and Saturn were known to the ancients, and even the Earth was not recognised by them as a planet. Uranus, Neptune, and the Asteroids have been discovered since the invention of the telescope.

Each planet moves round the Sun in an elliptical orbit. The following diagram represents the planets and their orbits in the order in which they are situated with regard to proximity to the Sun.

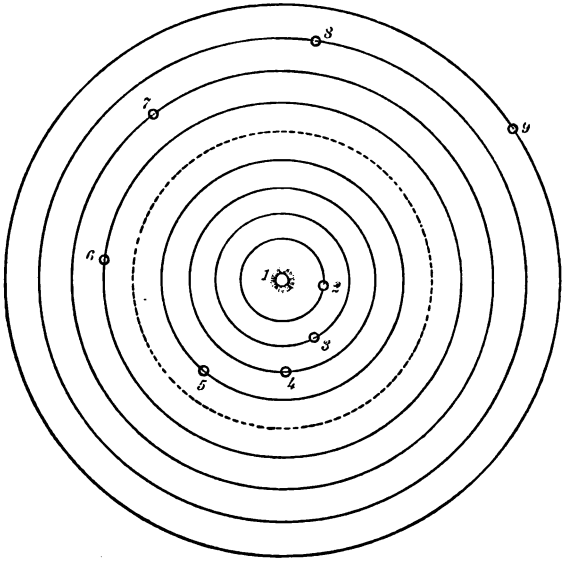
The planets Mercury and Venus, whose orbits are within that of the Earth, are called **inferior planets.**

The planets Mars, Jupiter, Saturn, Uranus, and Neptune, whose orbits lie outside that of the Earth, are called **superior planets.**

The orbits of the planets are all ellipses of various degrees of eccentricity. As a rule, the orbits of the smaller planets are more eccentric than those of the larger ones.

The plane of the equator of each planet, like that of the

Earth, is inclined to the plane of its orbit at a greater or less angle. This angle varies from 3° 4′ in the case of Jupiter to 100° 20′ in that of Uranus. Thus the variation of the seasons is widely different in the various planets.



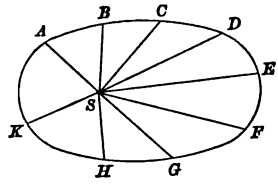
1. The Sun.	4. The Earth.	7. Saturn.
2. Mercury.	5. Mars.	8. Uranus.
3. Venus.	6. Jupiter.	9. Neptune.

The dotted line circle denotes the position of the Planetoids.

KEPLER'S LAWS.—The famous German astronomer, Kepler, who lived in the 16th and 17th centuries, discovered three laws relating to the motions of the planets and their distances from the Sun. They are as follows :—

1. The path or orbit of each planet is an ellipse, of which the Sun occupies one of the foci.

2. Equal areas of the ellipse are described in equal times.



Let A B C D E F G H K represent the elliptical orbit of any planet, and let the distances A B, B C, C D, D E, E F, F G, G H, H K, K A, be described in equal times. Then if the point S represent the centre of the Sun, the areas A S B, B S C, C S D, D S E, E S F, F S G, G S H, H S K, K S A are equal. Thus, though the *distances* vary, since the planet travels faster as it gets nearer to the sun, yet the *areas* are equal.

3. The squares of the periodic times are to each other in the same proportion as the cubes of the mean distances.

This is a remarkable relation existing between the mean distances of the planets from the Sun, and the times in which they perform their revolutions round it.

Thus, if P be the period of one planet (the Earth, for example), and D its distance from the Sun; also p the period of another planet, and d its distance; then—

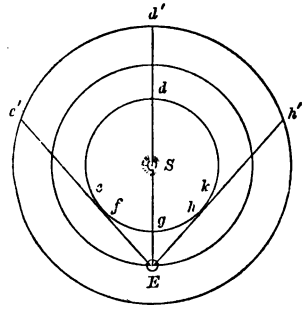
$$P^2 : p^2 :: D^3 : d^3$$

By means of this proportion, if we know three terms we can find the other. Thus, knowing the period of the Earth and its mean distance from the Sun, if we also know the period or the distance of another planet, we can find its distance or period.

Our readers can easily verify this law by applying it to the actual numbers which we shall give when we come to treat of the different planets.

APPARENT MOTION. Though the planets always travel in the same direction round the Sun, when viewed from the

Earth their courses seem very irregular. Sometimes a plane appears to travel with a direct motion, then it seems to remain stationary, and at another time its apparent motion is retrograde. The reason of this will appear from the following diagrams :—



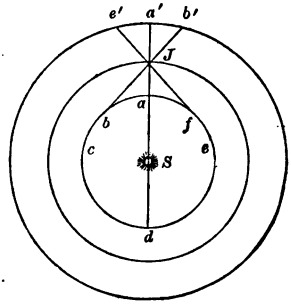
Let S represent the Sun, the inner circle the orbit of an inferior planet, Venus for example, the middle one the orbit of the Earth (E), and the outer one the circle of the heavens. As Venus passes from *d* to *e*, she will appear, to an observer on the earth, to move in a direct motion along the sky from *d'* to *e'* ; then for a short time as she travels from *e* to *f* she will appear stationary, or nearly so, till she arrives at *f*. As she moves from *f* to *g*, she will appear to travel with a retrograde motion from *e'* back to *d'*. Similarly, as she passes from *g* to *h*, her apparent motion will be from *d'* to *h'* ; then, as she moves from *h* to *k* she will appear stationary at *h'* ; and lastly, as she journeys from *k* to *d*, she will seem to travel once more with a direct motion from *h'* to *d'*.

Thus, during an entire revolution round the Sun, her motion will appear (1) direct, from *d'* to *e'*, (2) stationary, at *e'*, (3) retrograde, from *e'* to *d'*, (4) still retrograde, from *d'* to *h'*, (5) stationary, at *h'*, and (6) again direct, from *h'* to *d'*.

We have here supposed the Earth to be stationary, but it is evident that the apparent motion of the inferior planet will be still further complicated by the actual motion of the Earth.

Next, let the inner circle represent the orbit of the Earth, and the middle one the orbit of a superior planet, as Jupiter.

As the Earth makes a revolution in a much shorter time than Jupiter, it is evident that the apparent motion of the latter will depend mostly on the actual motion of the Earth. We will therefore now suppose Jupiter to remain stationary at J, while the Earth moves in its orbit.



As the Earth passes from *a* to *b*, Jupiter will appear, to a terrestrial observer, to move with a direct motion along the sky from *a'* to *b'*; then, as the Earth travels from *b* to *c*, Jupiter will appear stationary, or nearly so, at *b'*. As the Earth moves from *c* to *d*, Jupiter's apparent motion will be retrograde from *b'* back to *a'*. Similarly, as the Earth passes from *d* to *e*, Jupiter's apparent motion will still be retrograde from *a'* to *e'*; then, as the Earth moves from *e* to *f*, Jupiter will appear stationary at *e'*; and lastly, as the Earth journeys from *f* to *a*, Jupiter will be seen to travel once more with a direct motion from *e'* to *a'*.

It is evident that the apparent motion of Jupiter will be still further complicated by the actual motion of Jupiter himself in his revolution round the Sun.

MERCURY. This is the planet which has the smallest orbit, and is nearest to the Sun. Its mean distance from the Sun is about 35,400,000 miles, and it performs its revolution round the

Sun in a period of nearly 88 days, at the average rate of about 100,000 miles per second.

It is the smallest of the planets, with the exception of the asteroids, or planetoids, its diameter being only 2,962 miles at the equator. Hence it is about three times the size of our Moon.

As Mercury is never distant more than 30° east or west from the Sun, and is never above the horizon more than two hours either before or after the Sun, this planet is not often visible, and a favourable opportunity for observing him seldom arises. He may sometimes be seen through a telescope during the daytime.

The apparent diameter of Mercury varies according to his distance from the Earth. When nearest the Earth, at the inferior conjunction, it is about 12″, and when furthest from the Earth, at the superior conjunction, it is about 5″.

Mercury sometimes passes exactly between the Earth and the Sun, appearing to travel across the sun's disc. This is a **Transit of Mercury**, when the planet appears as a dark spot on the Sun's surface.

This planet does not always present the same appearance when seen through a telescope. It exhibits *phases* similar to those of the Moon, sometimes appearing like the new Moon, sometimes like a half Moon, and sometimes like the full Moon. These changes arise, as in the case of the Moon, from the fact that at different times a smaller or larger portion of the illuminated surface of the planet is turned towards us.

Mercury appears to shine with a brilliant white light. No spots have been accurately observed on his surface, though one German astronomer has professed to find traces of continents and oceans. The planet is believed to have a dense atmosphere, which moderates the scorching rays of the Sun shining upon it at such a comparatively short distance. It has no moons.

Mercury is remarkable for the great eccentricity or elongation of its orbit, exceeding that of any other planet. From this cause

it follows that the difference between his greatest and least distance from the Sun is more than 14 millions of miles, or about $\frac{2}{5}$ of the mean distance. In the case of the Earth the difference is only about 3 millions of miles, or less than $\frac{1}{30}$ of the mean distance from the Sun.

VENUS. This is the planet whose orbit is nearest to that of the Earth. Like Mercury, she never appears at a very great distance from the position of the Sun, though she recedes somewhat farther from it than that planet. She is, next to the Sun and Moon, the most brilliant and striking of all the heavenly bodies, sometimes appearing before the Sun as the Morning Star (Lucifer), and at other times after the Sun as the Evening Star (Hesperus). So great is the splendour of this planet's light, that it is capable of casting a shadow of a body on the Earth, and, under favourable circumstances, she may be seen shining in the sky in broad daylight.

The mean distance of Venus from the Sun is rather more than 66 millions of miles. Her orbit is nearly circular, hence the difference between her greatest and least distances from the Sun is comparatively small, less than a million miles. She completes her revolution round the Sun in a period of 224 days 17 hours, at an average rate of about 80,000 miles per second.

The diameter of Venus at the Equator is about 7,500 miles, being somewhat less than that of the Earth.

At the period of inferior conjunction, Venus is distant from us about 23 millions of miles; and at the period of superior conjunction, nearly 160 millions of miles.

When viewed through a telescope, this planet exhibits phases like those of the Moon. At the period of her greatest brilliancy she appears as a beautiful crescent when observed by the aid of a glass.

The great splendour of Venus, casting a dazzling and almost blinding light over her surface, renders her a difficult subject for telescopic observation. Hence, though she is so near to the Earth, little is known of her. Dusky spots appear on her surface, but they are supposed to belong, not to the planet herself,

but to the surrounding atmosphere. Some astronomers assert that they have discovered mountains more than 20 miles in height near the horns of the crescent. Observations of the movement of spots on the surface of the planet have led to the supposition that she revolves on her axis in a period of between 23 and 24 hours.

The **Transits of Venus** are of vast astronomical importance, as affording a means of ascertaining the distance of the Sun from the Earth, and from thence of calculating the distance of other heavenly bodies. They are of very rare occurrence; only one or two happen in the course of a century. The following are a few of the dates of former and future successive transits :— 1761, 1769, 1874, 1882, 2004.

Like Mercury, Venus has no satellite.

THE EARTH. As our own planet has been fully described elsewhere, it will be sufficient here to give briefly a few of the leading astronomical facts relating to it.

The Earth is the third planet from the Sun, taken in order of distance.

Its mean distance from the Sun is nearly 91,500,000 miles. The difference between its greatest and least distances from the Sun is rather more than three millions of miles. The Earth is in aphelion on the 21st of June, and in perihelion on the 22nd of December, so that it is actually more than three millions of miles nearer to the Sun in the middle of our winter than in the middle of our summer.

The Earth's diameter at the equator is 7,901 miles; at the poles 7,925 miles: mean diameter, 7,912 miles. It revolves on its axis in a period of 23 hours 56 minutes 4 seconds.

The Earth travels round the Sun in a period of 365·2563 days. Its equator is inclined to the ecliptic at an angle of about 23½ degrees.

The Earth has one satellite, the Moon, which revolves round it once in every 27 days 7 hours 43 minutes.

MARS. This is the fourth of the planets, and the first of the superior planets. He derives his name (that of the god

of war) from his fiery, red appearance, which has been ascribed to a dense atmosphere by which he is said to be surrounded. Recent observations have, however, tended to throw doubts on this theory. When viewed through a telescope, his surface is seen to be covered with spots irregular in shape and dusky in colour. These are supposed to indicate the outlines of continents and oceans. Near the poles there are two white spots, which seem to be caused by the presence of large masses of snow, as each becomes sensibly smaller according as each pole is turned towards the Sun. When nearest the Earth, he appears nearly as large as the planet Jupiter.

The mean distance of Mars from the Sun is nearly 140 millions of miles. The eccentricity of its orbit causes a difference of about 26 millions of miles between the distances from the Sun at aphelion and at perihelion. He performs a revolution round the Sun in a period of nearly 687 days. Hence his year is nearly twice as long as one of ours.

The diameter of Mars at the equator is about 4,920 miles. He is thus considerably smaller than the Earth, and than Venus, but much larger than Mercury.

As Mars is many millions of miles nearer to us at one time than at another, his apparent size varies considerably. His diameter appears about seven times as great when he is nearest to us than when he is furthest from us.

When viewed through a telescope, Mars exhibits phases like those of the Moon, but they are not so clearly defined as those of Venus.

The **ASTEROIDS**, or **PLANETOIDS**, as they are perhaps more correctly called, are a number of small planetary bodies revolving round the Sun in orbits situated between those of Mars and Jupiter. They may be regarded as invisible to the naked eye, though it is said that two of them, Ceres and Vesta, may be sometimes indistinctly seen without the aid of a glass.

The discovery of the Asteroids was mainly caused by the influence of **Bode's Law** on the minds of astronomers at the

commencement of this century. Professor Bode, of Berlin, had called the attention of scientific men to a curious relation existing between the distances of the planets from the Sun. This relation is expressed by a series of numbers, and is called Bode's Law, though he was not the original discoverer of it. Take the numbers 0, 3, 6, 12, 24, 48, 96, 192, forming a series in which each number after the second is obtained by doubling that which precedes it. If we now add 4 to each number, we obtain the following series :—

4, 7, 10, 16, 28, 52, 100, 196.

The numbers in this series represent with considerable accuracy the *relative distances* of the planets from the Sun. Thus, if 4 represent the distance of Mercury, then

7	will represent	the distance	of Venus,
10	„	„	the Earth,
16	„	„	Mars,
.	.	.	.
52	„	„	Jupiter.
100	„	„	Saturn.
196	„	„	Uranus.

It will be observed that we have no planet represented by the number 28, so that a gap occurs in the series which seems to require filling up. At the commencement of the present century, astronomers were not aware of the existence of any planetary body between the orbits of Mars and Jupiter. Bode, however, insisted on the probability of another planet existing between these bodies and corresponding to the number 28 in the series. His remarks so impressed several observers of the time, that they began to search for the required planet; and in 1801, on the very first day of the year and of the century, *Ceres*, the first asteroid, was discovered by Piazzi at Palermo, in Sicily. *Pallas* was discovered by Olbers in 1802, *Juno* by Harding in 1804, and *Vesta* by Olbers in 1807. Then were discovered *Astræa*, *Hebe*, *Iris*, *Flora*, *Metis*, *Hygeia*, *Parthenope*, and *Victoria* (the

last in 1850). New asteroids are discovered almost every year, and their number now amounts to upwards of two hundred.

These bodies vary in size, but they are all very small compared with the other planets. Their magnitudes have not been ascertained with accuracy, but the largest is not more than 228 miles in diameter, while some have a diameter of only a few miles.

Their orbits lie generally nearer to that of Mars than to that of Jupiter. The nearest to the Sun is Flora, which has a mean distance of 201 millions of miles, and revolves round the Sun in $3\frac{1}{4}$ years. The farthest is Maximiliana, which has a mean distance of 313 millions of miles, and performs a revolution in about $6\frac{1}{2}$ years.

Some of them revolve in orbits with great eccentricity; and in some cases their orbits are inclined to the ecliptic at a large angle. For example, the orbit of Pallas is inclined to the ecliptic at an angle of about $34\frac{1}{2}$ degrees.

It has been conjectured, with much appearance of probability, that each of these small bodies once formed part of one large planet which formerly revolved in its orbit at the distance represented by the number 28 in Bode's series, and which may have been broken into fragments through collision with another planet or from some other unknown cause.

JUPITER. This is by far the largest of the planets, and, with the exception of Venus, the most brilliant as seen from the Earth. He is named Jupiter, after the name of the King of the ancient gods, on account of his immense size and majestic appearance in the heavens. Like Venus, he is a Morning Star when seen before sunrise, and an Evening Star when seen after sunset.

The mean distance of Jupiter from the Sun is nearly 476 millions of miles. The eccentricity of his orbit is represented by a difference of nearly 46 millions of miles between his greatest and least distances from the Sun. He revolves round the Sun in a period of about $4{,}332\frac{1}{2}$ days; hence his year is nearly twelve times as long as ours.

The equatorial diameter of Jupiter is rather more than 85,000 miles. He revolves on his axis in the space of nearly ten hours; hence his diurnal revolution must be performed with amazing velocity, his day being shorter and his circumference greater than that of any other planet. The equator of the planet is inclined to the plane of the orbit at an angle of only a little more than 3 degrees. From these data we learn that the night and day of Jupiter are each on an average only five hours long, that they are nearly equal all the year round, and that there is very little change of seasons on the surface of the planet.

When viewed through a telescope, the surface of this planet appears marked with belts of a dark colour, and running generally parallel to the equator. As they vary in position and shape, they are supposed to be caused by the dense atmosphere of the planet, as affected by winds blowing over its surface.

Jupiter is attended by four moons or satellites, which revolve round it from west to east. They are invisible to the naked eye, and are said to have been discovered by the eminent astronomer Galileo, soon after the invention of the telescope in the early part of the 17th century.

The first satellite (Io) revolves round Jupiter in 1 day 18 hr., at a mean distance of nearly 270,000 miles, and has a diameter of about 2,250 miles. The second (Europa) completes its revolution in 3 days 13 hours, at a mean distance of about 425,000 miles, and has a diameter of about 2,100 miles. The third (Ganymede) performs its revolution in nearly 7 days 4 hours, at a mean distance of about 678,000 miles, and has a diameter of rather more than 3,400 miles. The fourth (Callisto) revolves round Jupiter in 16 days 16½ hours, at a distance of nearly 1,200,000 miles, and has a diameter of rather more than 2,900 miles. It will be seen that these satellites all travel much more swiftly than our Moon, completing far greater revolutions in a much shorter space of time. We also notice that they are of considerable size. The smallest is not quite so large as our Moon, while the two largest are greater than the planet Mercury.

As seen through a telescope, the positions of the satellites with regard to the planet vary greatly. Sometimes all four are seen on the same side of Jupiter, sometimes two are on one side and two on the other. At other times one or more are hidden behind the body of the planet, and on very rare occasions not a single satellite has been visible.

It has been ascertained that, as in the case of our Moon, all the satellites of Jupiter revolve on their axes in exactly the same time as they require to complete one revolution round the planet. Each satellite, therefore, always presents the same half of its surface towards Jupiter, the other side being always turned away from the planet.

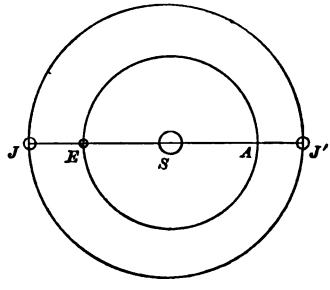
As the satellites of Jupiter are very small compared with the vast bulk of the planet round which they turn, each one of them suffers an eclipse every time that it arrives in that part of its orbit furthest removed from the Sun, since it is then in the shadow of the great planet. Thus the eclipses of Jupiter's satellites occur with great regularity, and being clearly visible to us through a good telescope, they can be calculated for any number of years in advance with the greatest accuracy. The first satellite having a comparatively small orbit, and completing each revolution in a short period, suffers very frequent eclipses, and observations taken in connection with them can be renewed at very short intervals, and are of the utmost value.

The times of the eclipses of Jupiter's satellites are published in a scientific publication called the *Nautical Almanac*, a work indispensable to navigators, and published several years in advance, for the convenience of seamen proceeding on long voyages, and of astronomers engaged in calculations which require information with regard to the position of stars, planets, etc., for some years beforehand.

By means of the eclipses of Jupiter's satellites, longitude may be ascertained by navigators out at sea. This is done in the following manner. The time of each eclipse is accurately set down in the *Nautical Almanac*, reckoning by Greenwich time. Now an observer on any part of the Earth's surface, by remarking

the moment at which a certain eclipse commences or ends, and referring to the almanac, knows the exact Greenwich time at that particular instant. By observing at what moment the Sun reaches the meridian altitude (noon), he is also able to ascertain the time at the particular spot in which he happens to be. A comparison of the two times will give him the longitude. For since the Sun appears to travel from east to west round the Earth in twenty-four hours, he seems to pass over one twenty-fourth part of the Earth's surface, or 15 degrees, during each hour. Thus noon arrives one hour later on the surface of the Earth for each interval of 15° to the west, and *vice versâ*. Hence if the observer finds that his time is two hours later than Greenwich time, he knows that his longitude is 30° W. If, on the other hand, his observations show that his time is three hours before Greenwich time, he knows that his longitude is 45° E. This mode of ascertaining longitude was formerly much more employed than at present; it has now been partially superseded by methods which are found more convenient in practice.

Observations of Jupiter's satellites led to the discovery of the rate of speed with which light is transmitted. The Danish astronomer Römer noticed that the eclipses of Jupiter's satellites



sometimes occurred a few minutes earlier, and sometimes a few minutes later, than the calculated times. Careful observations convinced him that these variations depended on the distance

of the planet from the Earth. He found that the eclipses happened nearly 16½ minutes earlier when the Earth and Jupiter were at their least than when they were at their greatest distance from each other. He then came to the conclusion that the 16½ minutes was the time which light required to travel over the space represented by the difference between the greatest and least distances of the Earth and Jupiter from each other. This difference is equal to the diameter of the Earth's orbit, as will appear from the accompanying diagram. The inner circle represents the Earth's orbit, and the outer circle that of Jupiter. S represents the Sun, E the Earth, and J, J' the planet Jupiter when at his least and greatest distances from the Earth. The difference between these two distances is evidently E A, which is the diameter of the Earth's orbit, about 183 millions of miles. From these data Römer inferred that light travels 183 millions of miles in about 16½ minutes, or at the rate of about 190,000 miles per second. These calculations have been amply verified by more recent observations of other astronomical phenomena.

SATURN. Next in order of distance from the Sun is the planet Saturn, the last of those known to the ancients, and the most remote of those clearly visible to the naked eye. It is frequently seen by night in our sky, and shines with a rather dull, feeble light.

The mean distance of Saturn from the Sun is about 872 millions of miles. The eccentricity of his orbit causes a difference of nearly 98 millions of miles between his greatest and least distances from the Sun. He revolves round the Sun once in about 29½ of our years, at a speed of 22,000 miles per hour.

The size of Saturn is enormous. As his diameter at the equator is nearly 72,000 miles, he is no unworthy rival of Jupiter himself, while he far surpasses every other known planet in magnitude.

The greatest distance from the Earth is about 1,000 millions of miles; while the least distance is about 831 millions of miles.

As he rotates on his axis in the short space of 10 hours 29 minutes, and therefore with enormous velocity, he is much flattened at the poles, like Jupiter.

Dark-coloured belts are observed on the surface of Saturn when seen through a telescope, but they are not so distinct and well-defined as those of Jupiter.

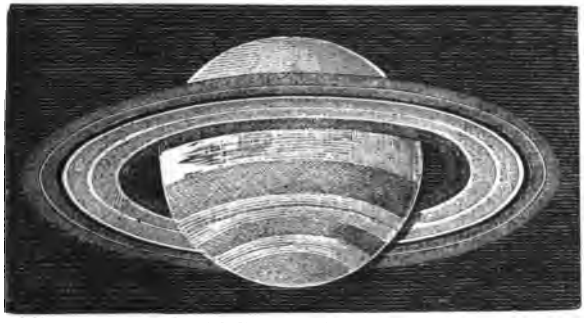
Saturn is accompanied by no less than eight satellites, which revolve round him in various periods of time. The first was discovered in 1789 by Sir W. Herschel, who also discovered another one two years later. Like the satellites of other planets it is supposed that each rotate on its axis in the same time in which it performs a revolution round the superior body.

The following is a table of the moons of Saturn, giving (in round numbers) the size, time of revolution, etc., of each :—

Name of Satellite.	*Distance from Saturn.*	*Time of each Revolution.*			*Diameter.*
	Miles.	d.	h.	m.	
Mimas	121,000		22	37	1,000
Enceladus . . .	155,000	1	8	52	not known
Tethys	190,000	1	21	18	500
Dione	246,000	2	17	41	500
Rhea	343,000	4	12	25	1,200
Titan	796,000	15	22	41	3,300
Hyperion . . .	1,007,000	21	7	8	not known
Japetus	2,314,000	79	7	55	1,800

The distinguishing feature of Saturn, that which makes it the most magnificent of all planetary bodies when seen through a telescope, is the series of rings by which it is surrounded. The true form of these appendages was not discovered at once. The peculiar appearance of Saturn was first observed by Galileo, who came to the conclusion that it was a triple-formed planet, the middle and largest body being attended by two smaller ones—one on each side. About forty years afterwards, when improved telescopes were in use, the Dutch astronomer, Huygens, announced that Saturn was surrounded by a ring which encircled the planet without touching it in any point.

Further discoveries have made known to us that what at first appeared to be only one ring is really a system or series of four



SATURN AND ITS RINGS.

or more rings, all in the same plane, but separated from each other by distinct intervals of space. These rings are broad, thin, flat, and opaque, or partly so, as they cast a shadow on the body of the planet. The inner ring is partly transparent, as the surface of Saturn can be seen through it.

The nature of these rings is still a matter of conjecture. Recent observations with telescopes of very high power have seemed to show that the system is composed of a considerable number of rings, one within another, revolving round the planet. Some astronomers now suppose that the rings consist of myriads of tiny satellites, each having an orbit of its own in which it revolves round the planet.

The whole of the rings, taken together, form a complete system, which may in a general way be regarded as a single ring. The distance from the centre of the planet to the outer edge of the ring is about 83,000 miles; to the inner edge 46,000 miles. Hence the entire breadth of the ring is about 37,000 miles. Its thickness seems to be not more than 100 miles.

The rings, like the planet and its satellites, are illuminated by the Sun; and the shadow of Saturn may generally be seen falling upon and darkening that portion of the circle which lies

furthest from the Sun. The use of the rings is probably to assist in giving light to the planet by reflecting the rays of the Sun upon its surface. The system of rings must exhibit a very magnificent appearance as seen from the surface of Saturn at night time.

As seen from the Earth, the system of rings varies in appearance according to the position in which it presents itself to an observer on the surface of our globe. Sometimes it takes the form of an ellipse, more or less elongated according as its plane is more or less inclined towards us. When the edge of the outer ring is directly turned towards the Earth, the system of rings takes the form of a straight line. On rare occasions, when the dark edge of the outer ring is turned towards the Earth, the rings vanish altogether from our view, or appear only as a faint line crossing the disc of Saturn.

URANUS. We now come to planets which have been discovered in modern times, and were entirely unknown to the ancients, who were without the aid of the telescope.

Uranus was discovered in 1781, by Sir William Herschel. It seems to have been previously sighted by other astronomers, but it had always been taken for a star, and to Herschel was reserved the honour of discovering that it is a planet. It can scarcely be said to be visible to the naked eye, though it may be indistinctly seen by persons of strong vision on a very dark and clear night, when it is in that part of its orbit which lies nearest to the Earth.

The mean distance of Uranus from the Sun is nearly 1,754 millions of miles. He revolves round the Sun in a period equal to rather more than 84 of our years.

His diameter is about 33,000 miles.

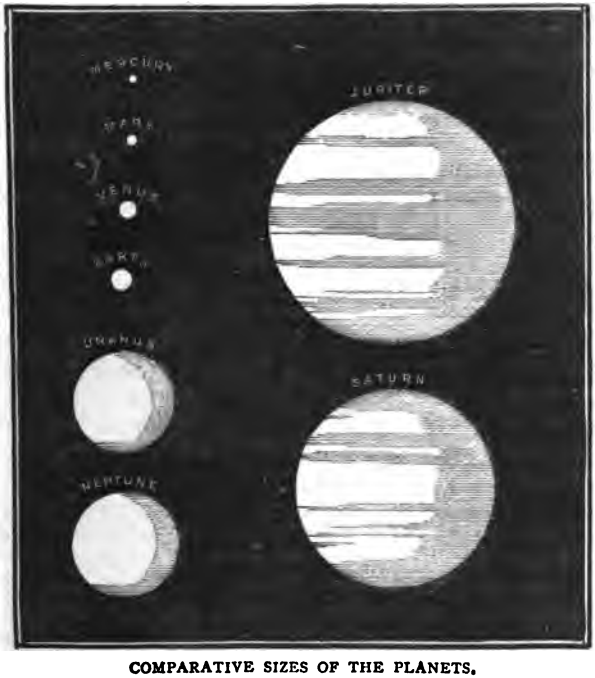
On account of his immense distance from the Earth, little is known of this planet. Neither spots nor belts have been observed on his surface, and the time of rotation on his axis is unknown.

Four satellites of Uranus have been discovered, and have received the names of Ariel, Umbriel, Titania, and Oberon.

This planet has sometimes been called *Herschel*, in honour

of the discoverer, and *Georgium Sidus*, a name given to it by Herschel, after George III. The name Uranus has now, however, generally superseded the others.

NEPTUNE. This planet is specially remarkable for the mode in which it was discovered. It had been observed that



COMPARATIVE SIZES OF THE PLANETS.

the path of Uranus did not exactly correspond with the calculations based on the known conditions of his motion. Two astronomers, M. Leverrier of Paris, and Mr. Adams of Cambridge, instituted independent investigations to account for the discrepancies; and each of them came to the same conclusion,

namely, that they were caused by the attraction of some unknown planet moving outside the orbit of Uranus. They then set to work, by a series of intricate mathematical calculations, to find out the *position* of the body which they supposed to exist. The positions arrived at by the two observers were very nearly identical. Leverrier was the first to give the result of his calculations to the world; and when, in 1846, Dr. Galle of Berlin directed the telescope of the Royal Observatory to that part of the heavens pointed out by the French astronomer, the new planet was almost immediately discovered.

The mean distance of Neptune from the Sun is no less than 2,746 millions of miles.

His equatorial diameter is about 36,500 miles, so that he is rather larger than Uranus.

Nothing is known of his surface, nor of the time of rotation on his axis.

Only one satellite has been discovered, but it is probable that a planet at such a vast distance from the centre of the solar system is provided with more than one moon, to make up for the deficiency of light received directly from the Sun.

TABLE OF THE PLANETS.

(*The numbers are approximate.*)

Name.	*Diameter in miles.*	*Distance from the Sun, in miles.*	*Period of Revolution, in days.*	*Period of Rotation, in hrs. and mins.*	*No. of Satellites.*
Mercury .	2,962	35,400,000	88	24 5	0
Venus . .	7,500	66,000,000	225	23 16	0
Earth . .	7,912	91,500,000	365¼	23 56	1
Mars . .	4,920	140,000,000	687	24 37	0
Asteroids .	—	—	—	—	—
Jupiter . .	85,000	476,000,000	4,332½	9 55	4
Saturn . .	72,000	872,000,000	10,759¼	10 29	8
Uranus. .	33,000	1,754,000,000	30,687	not known	4
Neptune .	36,500	2,746,000,000	60,126¾	not known	1

The Sun's diameter is 852,600 miles.
The Moon's diameter is 2,153 miles.

VI. COMETS.

Besides the planets, there are other less-known members of the solar system, called comets, from the Latin *coma*, a word derived from the Greek, and signifying "hair." A comet is so called from the hairy appearance given to it by the luminous vapoury substance which generally surrounds its densest part, and often extends far away from it in the form of a tail.

It is only in modern times that any reliable information has been gathered with respect to these apparently erratic visitors. The ancients regarded them with wonder and awe, as portending the ruin of kingdoms, famines, pestilences, earthquakes, and other dreadful disasters. This feeling of superstitious awe has descended to times still recent, and still exists among ignorant and uncivilized people even at the present day.

Perhaps the first man of science who gained any real knowledge with regard to comets, was Tycho Brahé, the eminent Danish astronomer, who lived in the sixteenth century. His observations of the comet of 1557 convinced him that that body must be at a greater distance from the Earth than that of the Moon and of some of the planets. These observations and discoveries disposed of all the theories which regarded comets as meteors or vaporous exhalations kindled in the atmosphere and moving about in it like falling stars or *ignes fatui*. Sir Isaac Newton, observing the comet of 1680, was led to the conclusion that it moved round the Sun in an elliptical orbit like those of the planets, having an *aphelion*, or greatest distance from the Sun, and a *perihelion*, or least distance from the Sun.

The following description has been given of the phenomena of a visible comet:—

"A faint luminous circle is discovered by aid of a good telescope; the appearance gradually increases, and after some time a *nucleus* appears, that is, a part in the middle which is more condensed in its light than the rest, sometimes circular, sometimes oval, sometimes even radiated like a star. The appearance

still goes on increasing, the nebula round the nucleus becomes less regular, and a tail begins to form, which looks as if one side of the nucleus were projected in a stream of light away from the body of the comet, which stream grows fainter as it recedes, and finally ceases without any definite boundary. This tail increases in length, so as sometimes to spread across the whole visible heaven; sometimes there are more tails than one, and sometimes the tail seems broken off in parts; it is generally turned away from the Sun, but this rule is by no means universal. The comet approaches the Sun, sometimes in an undulating and irregular curve, sometimes nearly in a straight line; it generally crosses the part of the heaven in which the Sun is found so near to the latter body as to be lost in its rays, but emerges again on the other side, usually with increased brilliancy and length of tail. The phenomena of disappearance are then, in the inverse order, the same as those of its appearance. Frequently it is observed that the dimensions of the comet contract a little as it approaches the Sun and dilate as it recedes again."

Thus there are usually three parts to a fully devoloped comet:—(1) the **nucleus**; (2) the **coma**, or luminous nebula surrounding the nucleus; and (3) the **tail**. The nucleus and coma together are sometimes termed the **head** of the comet. The nucleus is sometimes round, sometimes oval, and sometimes radiated like a star. The nucleus has been found to measure from 30 to 3,000 miles in different comets. Whether it is composed of any solid substance is still a matter of dispute. Some astronomers contend that a comet is wholly gaseous, without any solid matter whatever. It is said that stars have been distinctly seen through the very thickest part of comets. Sir John Herschel says, "Whenever powerful telescopes have been turned on these bodies, they have not failed to dispel the illusion which attributes solidity to that more condensed part of the head which appears to the eye as a nucleus; though it is true that in some a very minute stellar point *has* been seen, indicating the existence of a solid body."

For the ordinary observer the most striking portion of a comet is its tail. Some comets have no tail, others have more than one. The comet of 1743 is said to have had six tails, each more than thirty degrees in length. The tail of a comet is generally turned away from the Sun, but not always. Various theories have been formed to explain the nature of the tail of a comet. It has been said to be fed by the matter raised from the nucleus by the action of the Sun. Newton supposed that it is the result of a continual emission of molecules from the head of the comet. It has been likened to the "tail of smoke emitted by a running locomotive, the outer end being lost in space, and the inner one continually receiving a new supply of molecules." This illustration, however, seems at variance with the fact that the tail goes before a comet when it is receding from the Sun. A correspondent of the *Pall Mall Gazette* says: "There is evidence that the tail is a hollow cone, whose axis is a prolongation of the axis of the nucleus. The nucleus is revolving with one extremity of the axis always directed to the Sun, which exercises a repulsive power on the gaseous matter whirled from the interior of the nucleus."

The question has often arisen, What would be the effect if the Earth came in contact with the tail of a comet? The answer is, that there would most likely be little or no effect at all. The tail of a comet seems to be of such an unsubstantial nature, that the whole of it, though extending for millions of miles through space, may, as one astronomer says, weigh only a few ounces. Indeed, it is highly probable that the earth has more than once passed through the tail of a comet. The well-known astronomer, Mr. Hind, writing to the *Times* newspaper, attributed the phosphorescent appearance of the atmosphere on the night of January 30th, 1861, to the passage of the Earth through the tail of the comet which appeared in that year.

The sizes of comets are of the greatest variety, both with regard to the nucleus, the coma, and the tail. Many of them

have been measured with considerable accuracy. The nuclei are said to vary from about thirty to several thousand miles in diameter, and the tails from nothing to more than a hundred million miles in length. The comet of 1811 was calculated to have had a nucleus 2,600 miles in diameter, and a tail measuring 120,000,000 miles in length, and 15,000,000 miles in breadth.

THE GREAT COMET OF 1811.

With regard to the effect of comets, it has been generally supposed that their presence has caused an increased temperature on the surface of the Earth. The great heat which prevailed during the appearance of the splendid comet of the year 1881 was attributed to the influence of that body. This

opinion, however, seems to be a complete fallacy. During the appearance of the succeeding comet we experienced very cold, wet weather. It is said that the comet of 1680 was also attended by very cold weather.

An influence on the growth of vegetation has also been attributed to comets. The year 1811 was characterized by great heat, a good harvest, and an unusually fine vintage. The excellent wine made in that year was thought to owe its fine qualities to the influence of the comet, and was often called the *comet wine.*

The following years have been remarkable for the appearance of brilliant comets :—

B.C. 371, 134, 43 : A.D. 389, 891, 1106, 1264, 1402, 1456, 1472, 1531, 1556, 1577, 1607, 1618, 1652, 1664, 1655, 1658, 1680, 1744, 1759, 1769, 1807, 1811, 1835, 1843, 1853, 1858, 1881.

Perhaps the finest comet which has appeared during the present century, was that which was visible in 1811, and to which we have already alluded. It came no nearer to the earth than 141,000,000 miles, and yet its tail stretched over a large arc of the evening sky. Many persons believed at the time that it was the same mysterious body which appeared to the wise men at the birth of Christ. James Hogg, the Ettrick shepherd, thus addressed it :—

"Stranger of Heaven! I-bid thee hail!
Shred from the pall of glory riven,
That flashest in celestial gale,
Broad pennon of the King of Heaven!

"Art thou the flag of woe and death,
From angel's ensign-staff unfurled,
Art thou the standard of His wrath,
Waved o'er a sordid, sinful world?

"No; from that fine pellucid beam,
That erst o'er plains of Bethlehem shone,
No latent evil we can deem,
Bright herald of the eternal throne!

"Whate'er portends thy front of fire,
Thy streaming locks so lovely pale,—
Or peace to man, or judgment dire,
Stranger of Heaven, I bid thee hail."

This comet was calculated to revolve round the Sun in a period of more than 3,000 years; Bessel assigned to it a period of 3,383 years.

Halley's Comet is perhaps, from an astronomical point of view, the most famous of all the comets, as it was the first whose appearance was foretold with any degree of accuracy. Following up the discoveries made by Sir Isaac Newton, and carefully comparing the observations made on the comet of 1682 with those recorded of comets which had appeared in former times, he came to the conclusion that it was identical with those which had been seen in 1607, 1531, 1456, 1380, 1305, 1230, and 1155. He therefore ventured to assign to it a period of about seventy-five years, and to predict its reappearance early in the year 1758. His calculations were afterwards rectified by the French astronomers Lalande and Clairaut, aided by Madame Clairaut, who showed that the passage of the comet would be affected by the attraction of Jupiter and Saturn, and that its appearance would take place some months later. Their predictions were verified almost to the letter. The comet was first seen by George Palitzch, a farmer and amateur astronomer living near Dresden, who caught sight of it on Christmas-day, 1758. It reached its perihelion on the 12th March, 1759. This comet appeared again in 1835, arriving at its perihelion in November. Its next visit will take place in 1911. Halley's comet is now regarded as a regular member of the solar system, with a period of between seventy-five and seventy-six years. The greatest distance from the Sun is about 3,000,000,000 of miles, or only a little beyond the orbit of Neptune.

Encke's Comet is another well-known member of the solar system, which has a period of about 1,210 days, and therefore makes frequent returns to our neighbourhood. It was observed by Encke, a German astronomer, in 1818. Having identified it

with the comet seen in 1789, 1795, and 1805, he was able to predict its return in 1822. It was accordingly discovered in that year by Mr. Runker, at Paramatta. Observations on this planet have led Encke and other astronomers to believe in the existence of a resisting medium pervading the space through which the bodies belonging to the solar system have to pass.

When nearest to the Sun it is inside the orbit of Mercury, and when furthest from the Sun it passes between the planetoids and Jupiter. It is said to approach nearer and nearer to the Sun at each revolution.

Biela's Comet was so called after a French astronomer who observed it in 1826, when it is said to have passed within five million miles of the Earth. It was found to have a period of about six years and three-fourths. It appeared again in 1832, 1846, and 1852, and has not been seen since. At its appearance in 1846 it assumed the form of a *double comet*, with two distinct comæ, nuclei, and tails.

During the year 1881 six or seven comets were registered Two of these were distinctly visible to the naked eye in England, and presented a splendid appearance in the evening sky. The largest and most conspicuous was **Tebbutt's Comet**, seen in the northern heavens during the months of June and July. It reached its perihelion on June 16th, when its distance from the Sun was about 67 millions of miles. It made its nearest approach to the Earth five days afterwards, when its distance from us was about 30 millions of miles. According to some observers, its nucleus measured 700 miles in diameter; its coma 200,000 miles in diameter; and its tail 50 millions of miles in length.

TIDES.

Tides are the movements of the waters of the ocean when they rise and fall at nearly regular intervals, advance upon the land and up the mouths of the rivers, and then retire to a lower level. The rising of the water is called the **Flow**, its retirement the **Ebb**, of the tide. There are two flows and two ebbs of the

tide in 24 hours 50 minutes and 28 seconds, so that each flow and each ebb occupies nearly six hours and a quarter. When the flow reaches its maximum height, it is said to be **high water**; when the ebb arrives at its mimimum elevation, it is said to be **low water.**

Causes. The tides are caused by the attraction of the waters of the ocean by the Sun and Moon. Though the Sun is much larger than the Moon, the latter has a greater attractive force on the waters of the Earth, because its distance is vastly less. Hence the influence of the Moon in the formation of the tides is much more powerful than that of the Sun. The period of 24 hours 50 minutes and 28 seconds is the length of time which any given spot on the Earth's surface, carried by its diurnal revolution, takes to come back to the same relative position with regard to the Moon as it occupied at the commencement of the period.

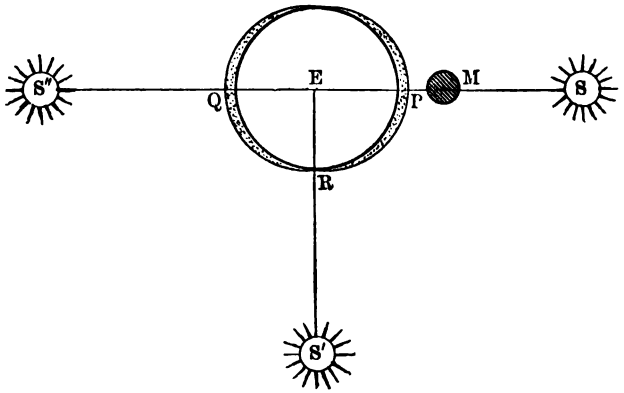
The attraction of the Sun and Moon is of course exerted on the whole mass of the Earth; but since the water has a smaller cohesive power than the land, it yields more readily to the force applied to it, and is heaped up on that side of the globe which is turned towards the attracting bodies.

In the accompanying diagram let E represent the Earth, S the Sun, and M the Moon. The waters of the globe are drawn towards P by the joint attraction of the Sun and Moon acting in the same direction along the line E S. In this position, where the Sun and Moon are both on the same side of the Earth, their attractions exert their maximum influence on the waters of the Earth, because they act in the same direction.

The student will readily see that the water is now raised at P, but he will not so easily comprehend the fact we now mention; namely, that *at the same time* there is also high water at Q, on the opposite side of the world. The explanation is this; the water at P is raised by its being drawn away from the Earth, whilst the water at Q is raised by the Earth being drawn away from *it*. The Earth is attracted most at P, less at the centre E, and less still at Q. Hence the water at Q is, as it were, left

behind by the other parts of the globe, and is heaped up on that side at the same moment that it is elevated on the other side, nearest to the Sun and Moon. Thus each of the two bodies, the Sun and the Moon, tends to produce a flow of the tide both on the side nearest to itself and also on the opposite side at the same moment.

The highest tides will therefore occur when the Sun and Moon are on the same side of the Earth, as at S and M, or on opposite sides of the Earth, as at S″ and M. The former position occurs at the time of New Moon, when the Sun and Moon are said to



be **in conjunction**; the latter position occurs at the time of Full Moon, when the Sun and Moon are said to be **in opposition.** These highest tides are called **Spring Tides**; they happen twice during each lunar period. The spring tides do not, however, occur *exactly* at the times of New and Full Moon, but about a day and a half afterwards, since the waters require some time to obey fully the forces applied to them.

It will be evident that when the flow of the tide rises highest at high water the ebb will fall lowest at low water, since an accumulation of water in one portion of the globe must be

counterbalanced by a corresponding depression in that from which the water is withdrawn.

When the Moon is at M and the Sun at S', their attractive forces act along the lines M E and S' E, which are at right angles to each other. In this position the two forces in some degree counteract each other; but the attraction of the Moon being much greater than that of the Sun, the waters obey the impulse given to them by the former, but to a diminished degree. The position referred to occurs when the Moon is in her first and third quarters (at the time of *Half-Moon*), or in **quadrature**, as it is termed. The tides which happen at these times are the lowest; they are called **Neap Tides.**

The Tidal Wave. The movement of the waters of the ocean to obey the attractive forces of the Sun and Moon is called the tidal wave. It varies in force, direction, and velocity in different parts of the world on account of the obstacles offered to its progress by the masses of land it meets with in its passage. In the open ocean it moves rapidly and in a regular course, but in narrow and shallow seas its flow is slow and interrupted. On the other hand, for obvious reasons, the tide rises highest where its progress is most impeded, and the water is consequently more confined. It rushes with great force through narrow straits and up the gradually narrowing and funnel-shaped mouths of rivers; and it is in situations of this kind that it attains its greatest height. In the River Severn, for instance, the tide sometimes rises to a height of forty or fifty feet. In the Bay of Fundy, in North America, a height of more than 100 feet has been registered, while in the open waters of the Pacific the difference between high and low water is often not more than two or three feet. Sometimes the tide rushes up in a great wave which can be seen for miles before it arrives. This is called the **Bore.** At the mouth of the Brahmapootra, for example, the bore attains the height of about twelve feet. This phenomenon is also observed in the Hooghly, a branch of the Ganges, in the Bay of Fundy, in the mouth of the Severn, and other places.

ENGLISH HISTORY.

An outline of the History of England is contained in the Books for the three preceding years of the Pupil Teachers' Course. In this volume we give an account of the British Constitution, and some answers to Questions set at Examinations for Pupil Teachers.

THE BRITISH CONSTITUTION.

By the **Constitution** of a country is meant the system by which its government is carried on. Properly speaking, the term is only used in reference to a country which enjoys a certain amount of freedom, and has to some extent the right of self-government. A nation which is subject to the absolute control of a despotic monarch cannot be said to have a Constitution, since there are no fixed rules and methods by which the laws are made and administered.

The British Constitution is a **Limited Monarchy.** It is the most celebrated in the world. It has grown up naturally and gradually during many centuries, often amid fierce struggles between the champions of liberty and the supporters of arbitrary power. During these centuries the rights of the people were almost constantly gaining ground, till at length the English nation has become possessed of a system of government which secures to it freedom of person and property and a due share in making and administering the laws. Under the British Constitution we are enabled to live peacefully and contentedly, certain of enjoying the rights of free citizens, while exempt from the social and political disturbances which often shake other less favoured lands to their foundation.

The British Constitution is the admiration of the world, and has been the model on which nearly all the free constitutions which now exist have been formed. The United States, the British colonies, France, Germany, Spain, and many other states have systems of government framed after the pattern of the English system. England has not only gained freedom for herself, but for many other nations; perhaps ultimately for the whole world. It is her proud boast that she is the "mother of free nations," the "classic land of liberty."

One of the most remarkable features of the British Constitution is its stability. Many other nations have been free for a time, but after awhile liberty has degenerated into licence, and has given place to despotism. The solidity of the British system is due to two sentiments which exist in the minds of the people, and which have grown with the progress of the Constitution; their ardent love of liberty, and their equally intense love of order and respect for the laws.

As an example of the feelings with which the British Constitution is regarded abroad, we quote the following passage from the works of the celebrated French writer Montalembert, who died a few years ago:—"It has only been by force of courage, of patience, of an earnest faith in justice and good sense, that they (the English people) have entered into the enjoyment of that constitution which has cost them so dear, but which is worth all that it has cost, and which has gained the admiration of the most lofty and of the most varied minds."

I. THE RIGHTS OF THE PEOPLE.

Every Englishman regards himself as a free citizen, subject only to the control of the laws and of the Constitution, which have been formed by the people themselves. His fundamental rights are:—

(1) The right of **Personal Security**, comprising the "legal and uninterrupted enjoyment of his life, his limbs, his body, his health, and his reputation."

(2) The right of **Personal Liberty**, consisting in "the power of locomotion, of changing situation, or removing one's person to whatsoever place one's own inclination may direct, without imprisonment or restraint, unless by due course of law."

(3) The right of **Property**, which consists in "the free use, enjoyment, and disposal of all his acquisitions, without any control or diminution, save only by the laws of the land."

These rights are secured to him by the Constitution, and have been repeatedly affirmed in Magna Charta, the Petition of Right, the Habeas Corpus, the Bill of Rights, and the Act of Settlement. All these great charters of English liberty have been described in our sketch of English History, and it would be an instructive exercise for the pupil to examine them carefully with a view of observing the manner in which each of these fundamental rights has been asserted and secured.

II. THE LEGISLATIVE POWER.

The Laws of England consist of two parts (see also p. 175):—

(*a*) The body of ancient usages, called the *lex non scripta*, or unwritten law, consisting of general customs which have obtained a legal force and are acted on in the courts of justice. This has long been established by use and precedent, and its validity in any particular case is determined by the judges in the courts of justice according to the records of the several courts, which are preserved and referred to for that purpose.

(*b*) The **Statute Law**, called also the *lex scripta*, or written law, made by "the king's majesty, by and with the advice and consent of the lords spiritual and temporal, and commons, in Parliament assembled." The statute law is superior to the unwritten law, since the King and Parliament have power to abolish old laws and make new ones. The oldest of the statute laws now extant is Magna Charta, as confirmed in Parliament 9 Henry III., though no doubt many existed before that time whose records have been lost.

The statute law consists of Acts of Parliament made from time to time by the Legislative Power, called also simply the Legislature. Technically the term Parliament is held to include the three branches of the Legislature, consisting of the **King, Lords,** and **Commons**; but the term is usually employed to denote only the two houses of Lords and Commons.

THE SOVEREIGN. The Sovereign is the head of both the Legislative and the Executive Powers. The office is hereditary, and may be held by either a male or female descendant of previous sovereigns, according to fixed rules of primogeniture. In ordinary cases the eldest son of the preceding monarch succeeds to the throne; if male issue fail, then the eldest daughter becomes queen. If a monarch die leaving no direct heirs, the crown descends to his eldest surviving brother or his heirs, and so on.

The Sovereign has the sole right of assembling Parliament. It cannot meet without being summoned by him through his Ministers. Each session of Parliament is opened by the Sovereign in person or by deputy. No law can be passed without receiving his assent. The Parliament is prorogued and dissolved by the Sovereign, unless it has existed for a full period of seven years.

The legislative powers of the Sovereign are all exercised through the Ministers, who are responsible to Parliament.

It is now unusual for a Sovereign to refuse the royal consent to any bill passed by both houses.

THE HOUSE OF LORDS, also called the Upper House. This consists of—

(*a*) **Lords Spiritual,** including the two English archbishops and twenty-four English bishops.

(*b*) **Lords Temporal,** including dukes, marquises, earls, viscounts, and barons. The number of English peers is variable, since the Sovereign has the power of creating them at pleasure. At present there are nearly 300. This house also contains 45 Scottish hereditary peers, 80 Irish hereditary peers, 16 Scottish

peers elected for each Parliament, 28 Irish peers elected for life, and also 3 peers elected for life and styled "Lords of Appeal." These latter are chosen from distinguished English, Scotch, and Irish judges to assist the House of Lords when sitting as the highest court of justice; they also enjoy all the powers and rights of ordinary peers.

The **Lord Chancellor** sits on the woolsack, and acts as the president of the House of Lords.

The House of Lords is attended by the principal judges, and it is the highest **court of appeal** in civil cases.

A peer has the right of voting by **proxy**, that is, of appointing another peer to vote for him in his absence.

He has also the right of entering in the journal of the house his **protest** against any vote passed in the assembly.

Any bill, except a money-bill, may originate in the House of Lords.

THE HOUSE OF COMMONS, also called the Lower House. This consists of representatives chosen by **counties, boroughs,** and **universities** of England, Scotland, and Ireland. England is represented by 493, Scotland by 60, and Ireland by 105 members.

In *boroughs* members are elected by a majority of voters, who are householders paying poor-rates, or lodgers paying not less than £10 per annum for rooms; in *counties* owners of freehold property of an annual value of £2 or over and tenants paying a rent of not less than £12 per annum are entitled to vote.

The president of the House of Commons is called the **Speaker.** He is elected by the House at the commencement of each new Parliament.

The members of the House of Commons are chosen every seven years unless, as generally happens, the Parliament is dissolved before the expiration of that period, when a new election takes place.

The power of the House of Commons is very great. Any bill can originate in this house; money-bills *must* originate there. It has the command of the national purse, with the power of granting or refusing supplies, and therefore of controlling the

action of the Executive. By constitutional usage the Prime Minister is obliged to command a majority in the House of Commons; hence the policy of the Government is under its control.

POWERS OF PARLIAMENT. The authority of Parliament is practically unlimited. It can make, repeal, and amend laws, regulate the succession to the throne (as in the reigns of Henry VIII. and William III.), alter the established religion of the land (as in the reign of Henry VIII., and recently in the case of the Irish Church), "change and create afresh the Constitution of the kingdom and of parliaments themselves, as was done by the Act of Union and the several statutes for triennial and septennial elections, and, in short, do everything that is not naturally impossible to be done."

PRIVILEGES OF PARLIAMENT. Members of Parliament have great and undefined privileges. The best known are freedom of debate and freedom from arrest (except for felony, treason, seditious libels, and breach of the peace). To assault by violence a member of either house, is a high contempt of Parliament.

ASSEMBLING AND DISMISSAL OF PARLIAMENT. The Parliament is called together and dismissed by the Sovereign, acting through the advice of his ministers. Each session of Parliament is opened by the Sovereign in person or by deputy, generally the Lord Chancellor. At the opening of Parliament the king's (or queen's) speech is read either by the monarch himself or by the Lord Chancellor. The ceremony of opening Parliament takes place in the Lords' Chamber, to which the Commons are summoned. The latter appear in the person of the Speaker, who is accompanied by a number of the members of the Lower House, chosen by ballot.

An **adjournment** is a continuance of a session from day to day. Sometimes the houses adjourn for a fortnight or a month together, as at Easter. Each house may adjourn separately.

A **prorogation** is the continuance of the Parliament from one session to another. Both houses are prorogued at the same time by the royal authority. A king's (or queen's) speech is read at the prorogation of Parliament.

A **dissolution** is the "civil death of the Parliament," and may be effected in three ways :—

1. **By the king's will,** expressed either in person or by representation.

2. **By the demise of the Crown.** Formerly the dissolution took place immediately on the death of the Sovereign; but by later enactments a Parliament may continue in existence six months after the king's decease.

3. **By length of time.** By the Septennial Act, passed in the reign of George I., the duration of Parliament is limited to seven years.

PROCEDURE OF PARLIAMENT. Legislation is conducted in Parliament by means of bills. A bill is a draft of the law which the Parliament is invited to make. If the bill relate to a private matter, it is introduced by petition.

Public bills are usually introduced by the Sovereign's Ministers, who are considered responsible for the general legislation of the country.

The first step is, to obtain *leave to bring in the bill*, which is printed and distributed among the members for examination.

Then application is made for the bill to be *read a first time*, which is seldom refused.

The next stage is for the bill to be *read a second time.* On this occasion its general principle comes under discussion, and if it be not approved, it is thrown out by the house.

The usual mode of rejecting a bill is by voting ironically that it "be read this day six months," that is, after the conclusion of the session.

If the bill pass the second reading, it is then discussed clause by clause *in committee.* If the bill be an important one, the committee consists of the whole house; but the Speaker leaves the chair, and the Chairman of Committees takes his place. Many alterations are often made in the bill during this stage of its progress, and when it has passed the committee it is *reported* to the house in its revised form, and after another consideration by the whole house is brought up for the *third reading.* The final stage is a motion "That this bill do pass."

If this is agreed to, the bill is then sent to the other house, where it has to pass through the same forms as before. It may be rejected at either reading, or may be altered in any of its clauses in committee.

When it leaves the second house, it has to be sent back to that in which it was introduced, in order that any amendments made in it may be considered. If these are not agreed to, a conference takes place between members of the two houses, who usually adjust the difference; but if both remain inflexible, the bill is dropped.

If the houses come to an agreement, the bill is then sent up to the Sovereign, to receive the royal assent. This is given either by the monarch in person or by commission. The royal consent has not been withheld from a bill which had passed both houses since 1707, when Queen Anne refused to pass a bill for settling the militia in Scotland.

Bills are usually introduced in the House of Commons. Those affecting the rights of the peerage are, by the custom of Parliament, originated in the Upper House, and suffer no changes or amendments in the House of Commons.

III. THE EXECUTIVE POWER.

The actual government of the country, consisting in the administration of the laws and the direction of the relations of the country with foreign states, is supposed to be vested in the Sovereign, whether king or queen, who is thus the supreme executive authority. By the Constitution, however, this executive power must be exercised through Ministers, who are responsible to Parliament.

There are two important maxims with regard to the Sovereign which require to be mentioned here:—

(*a*) *The king can do no wrong, i.e.*, in his political capacity. This ancient constitutional principle signifies, that as the king can only act through his Ministers, any wrong which is committed by the Executive Power must be imputed to them, and

they are liable to be called to account for the advice which they have tendered to the Sovereign.

(*b*) *The king never dies.* "Henry, Edward, or George may die; but *the king* survives them all. For immediately upon the decease of the reigning prince in his natural capacity, his kingship or imperial dignity, by act of law, without any interregnum or interval, is vested at once in his heir, who is *eo instanti* (at that instant) king to all intents and purposes."

THE KING'S PREROGATIVES. The law ascribes to the king the attribute of sovereignty, or pre-eminence. As already stated, the supreme executive power resides in him. Hence he is invested with certain authorities, powers, or prerogatives, the principal of which are the following :—

1. With regard to foreign concerns, the king is the delegate or representative of his people. Hence he can—

(*a*) Send ambassadors to foreign states, or receive them at home.

(*b*) Make treaties, leagues, and alliances with foreign states and princes.

(*c*) Make war or peace.

2. He is a constituent part of the supreme legislative power. (This is a prerogative relating to the legislative rather than to the executive capacity of the king.)

3. He is considered as the generalissimo, or first in military command, within the kingdom. Hence he has the sole power of raising and regulating fleets and armies.

4. He is the fountain of justice and general conservator of the peace of the kingdom. Hence he has the right of erecting courts of judicature, of appointing judges, and of granting pardons.

5. He is the fountain of honour, of office, and of privilege. He confers dignities and honours. Degrees of nobility, of knighthood, and other titles are received by immediate grant from the Crown.

6. As the arbiter of domestic commerce, he regulates the currency; and the coin of the realm is stamped with his image and superscription.

7. He is the head and supreme governor of the National Church.

These vast powers, if wielded by the monarch in person, would be fatal to the liberties of the people. By the Constitution, however, they are effectually kept in check.

(*a*) They can only be exercised through Ministers, who are practically subject to removal by an adverse vote in Parliament, and are liable to impeachment for any improper discharge of their functions.

(*b*) The House of Commons has command of the public revenues. Hence, for example, it would be impossible for the Sovereign to carry on a war without the concurrence of the Parliament. He could not raise armies or fleets nor appoint judges without the necessary funds, which the House of Commons would not grant if they disapproved of the objects for which the money was intended to be employed.

THE MINISTRY. THE CABINET. For many centuries the King has been accustomed to choose a body of councillors called the Privy Council, to assist him with their advice and to aid him in the administration of the affairs of the kingdom. In modern times it has grown into a custom for the Sovereign to select as his principal adviser the leading member of the political party which has a majority in the House of Commons. The Minister thus selected chooses other eminent politicians to preside over the several departments of the government. A Ministry is thus formed which is supposed to represent the prevailing opinions of the country, and through it the powers and prerogatives of the Sovereign are exercised. The chief members of the Ministry are :—

1. **The First Lord of the Treasury,** also called the **Premier,** or **Prime Minister.** He is the head of the Government, and may be a member of either house of Parliament. His salary is £5,000 per annum. Nominally he is chosen by the Sovereign, but virtually by the party to which he belongs, since it is well known to the country and to the king who is the acknowledged chief of each of the great political parties.

2. **The Lord Chancellor,** who is the head of the legal branches of the Executive. He presides over the House of Lords, nominates the judges, advises the Cabinet in legal affairs, and is one of the judges of the Supreme Court of Judicature. He is the highest officer of the Crown and keeper of the great seal. His office is one of the most ancient and dignified in the kingdom. The salary of the Lord Chancellor is £10,000 per annum.

3. **The Chancellor of the Exchequer,** who is the chief minister of finance, and administers all affairs connected with the national expenditure and taxation. This minister must, according to constitutional usage, be a member of the House of Commons. At an early part of each session he makes a statement, called the *Budget*, to the House of Commons, in which he explains in detail the state of the public revenues, the proposed expenditure for the ensuing year, the kinds and amount of taxation deemed necessary for the public service. The Prime Minister sometimes holds this office in conjunction with that of First Lord of the Treasury. The Chancellor of the Exchequer was formerly a judge of the Court of Exchequer (now abolished). All revenue causes are heard by the High Court of Justice (Queen's Bench Division).

4. **The Secretary of State for the Home Department,** called also shortly **The Home Secretary.** He manages the business connected with what may be called the domestic affairs of the nation, as the police, the administration of justice, and matters connected with public health and public order. As he administers the royal prerogative of *pardoning*, he can revise the sentences of the courts in favour of prisoners. Hence we sometimes find him exercising the important function of commuting the capital sentence pronounced against a prisoner, or even of setting him at liberty altogether.

5. **The Secretary of State for Foreign Affairs,** called also shortly **The Foreign Secretary.** He administers the foreign business of the country, conducts the correspondence between the English Government and that of other countries with which

we have dealings, and explains the foreign policy of the Cabinet to Parliament.

6. **The Secretary of State for the Colonies,** called also shortly **The Colonial Secretary.** He transacts the public business connected with the colonies, forming a link between them and the home Government, and advises the Sovereign as to the acts of the colonial legislatures which require his consent. He nominates governors to the colonies, and is answerable to Parliament on all matters of colonial policy.

7. **The Secretary of State for India,** called also shortly **The Indian Secretary.** He regulates the affairs of India, and controls the policy of the Viceroy of that country. He is assisted by a council of fifteen persons, but is not bound to act according to their advice.

8. **The Secretary of State for War.** He has control of affairs connected with the army, preparing and explaining to the Parliament the estimates for military purposes.

9. **The President of the Privy Council,** also called the **Lord President of the Council.** This office is not so important as formerly. Many of its duties are now obsolete. In ancient times the Privy Councillors were a very important body, and they are still numerous; but the chief functions discharged by them are in the hands of select committees, such as :—

(*a*) **The Judicial Committee of the Privy Council,** forming a court of appeal in cases connected with the colonies, with India, and with ecclesiastical affairs.

(*b*) **The Committee of Council on Education,** which controls the expenditure of the public grants for the education of the poor. It issues annually a Revised Code containing the Government regulations for the administration of public elementary schools.

(*c*) **The Board of Trade,** properly a Committee of the Privy Council. (*See* President of the Board of Trade.)

The Ministers above mentioned form the Cabinet, who meet in council, deliberate together on public affairs, and resolve on the policy to be adopted in the government of the country. They are for the time being the virtual rulers of the nation.

The Ministers named below do not belong of necessity to the Cabinet, but they perform important functions, and most of them have at various times been admitted to a seat in the Cabinet itself.

10. **The President of the Board of Trade.** He presides over the committee already named, and arranges all matters relating to internal trade, foreign commerce, manufactures, railways, canals, statistics, excise regulations, etc.

11. **The First Lord of the Admiralty.** He is the chief of six Lords of the Admiralty, who regulate matters connected with the navy, such as the building and repairing of ships of war, the construction and maintenance of dockyards, superintending the naval and coast-guard forces, and distributing prize money to the sailors.

12. **The Lord Privy Seal.** The office which he holds is now almost purely honorary, the duties attached to it having almost entirely fallen into disuse.

13. **The Chief Secretary for Ireland.** He is the chief secretary of the Lord Lieutenant of Ireland, and is the representative of the Government in Parliament with respect to matters connected with Ireland.

14. **The President of the Local Government Board.** He presides over a Board appointed for the purpose of controlling bodies elected by the ratepayers in various localities, examining their byelaws, checking their action and expenditure when necessary, and preventing them from infringing any of the general laws of the country. It thus exercises authority over Local Boards created for the relief of the poor, the enforcement of sanitary laws, making and repairing roads, and other similar objects.

15. **The Postmaster-General.** This Minister is at the head of the Post Office. He administers all matters relating to that office, such as the transmission of letters, the inland telegraph business, the money-order system, the post-office saving-banks, and the post-office insurance and annuities departments.

16. **The Chancellor of the Duchy of Lancaster** controls the revenues of the Palatine County of Lancaster, and is the

judge of the only remaining local court which has a jurisdiction coextensive with the High Court of Justice. All causes of complaint which are assigned to the High Court of Justice (Chancery Division) may, if arising in Lancashire, be brought before the Chancellor of the Duchy of Lancaster, in what is styled the Palatine Court. As a matter of fact, the Chancellor himself does not sit to hear these causes, but his judicial functions are performed by a barrister of high standing and repute, who sits at Liverpool or Manchester for many weeks, and during the rest of the year in London. A very large amount of judicial business is brought before him. The office of Chancellor of the Duchy of Lancaster is often filled by an eminent member of the Cabinet.

17. **The Vice-President of the Committee of Council on Education.** He is the representative of the Education Department in the House of Commons, and is generally supposed to be the virtual chief of that department.

Each Minister is responsible for the discharge of the duties connected with his particular office; but he is liable to be controlled by the general policy of the Government to which he belongs, and more especially by the Prime Minister, to whom the country looks for the proper administration of public affairs as a whole. Hence any member of the Government who finds that he cannot work in harmony with his chief, and with the other members of the Administration, is bound in honour to resign his post, which is then filled up by the Premier.

IV. THE LAWS OF ENGLAND.

BY A BARRISTER-AT-LAW.

RIGHTS and WRONGS.—In morals, rights and wrongs express what ought to be and what ought not to be. In jurisprudence, rights and wrongs express that which, as belonging to a person, he may vindicate by judicial aid.

LAWS are rules of conduct prescribed and sanctioned by the supreme power in a State, commanding what is right and prohibiting what is wrong.

JURISPRUDENCE is the knowledge of the laws and of the grounds on which they rest; and of the application of them to judicial determinations for the enforcement and protection of right and the prohibition of wrong.

THE LAWS OF ENGLAND may be classified under two headings: the **Lex non Scripta**, or **Unwritten Law**; and the **Lex Scripta**, or **Written Law**. These comprise what is called **The Common Law**, that is, a *law common* to the whole realm.

The Unwritten Law has been handed down to us from the earliest periods of our history: in those ages when the people were in a state of utter ignorance, by word of mouth, and for centuries past, in the reports of the judges on matters brought before them, and in the treatises of different writers. The unwritten law, which is the foundation of the Common Law, may be termed a mass of legal customs. Limited and narrow in times of high antiquity, the unwritten law has increased with the necessities of succeeding generations, and has assumed such vast proportions that it is not easy to credit its remote origin.

The Written Law embraces the statute law of the realm. For a people given up almost wholly to the pursuit of war, the unwritten law was in distant ages found sufficient; as civilization advanced, and society emerged by slow degrees from its rude primitive form, the unwritten law bent and strained itself to meet the growing needs. Later on, when it became inadequate to mankind, or when those charged to administer it could no longer enlarge its scope, and it proved in some instances contrary to public policy and to the rising spirit of enlightenment, the Legislature stepped in, and by various enactments altered, varied, and, where doubts had arisen, explained it. These enactments, ever increasing in number as the times required, constitute the written, or statute law.

Equity.—In addition to legislative enactments, as a means of correcting, adding to, and interpreting the unwritten law, a practice sprang up about the middle of the fifteenth century of presenting petitions to the king in matters where the courts administering the common law gave no relief, or no proper

relief. These petitions the king referred to his ordinary Council. In early times this Council, of which the Chancellor was one of the chief officers, had exercised considerable judicial power. The authority of the Council seems to have been paramount; and from a custom of taking a share in its business, the Chancellor appears to have established a separate court of his own. This court exercised no original system of judicial decision; but used its power by restraining suitors who had obtained decisions in the ordinary courts of common law from acting upon and turning them to their advantage, whenever such decisions appeared unjust or against conscience. This restraining power was first employed in matters relating to trusts. The courts administering the common law had, by laying down some highly technical and rigid rules, refused to recognise, or at least to enforce, trusts. Where a person held land in trust for another, the common law declined to interfere so as to bind the trustee's conscience. He was the legal owner of the property, and beyond his legal rights the common law would not look. But the Chancellor, on being appealed to, restrained a trustee who had recovered lands at common law from converting them to his own use. In this manner sprang up that system of equity jurisprudence, which was for so long a period administered by the High Court of Chancery. Besides trusts, this court little by little began to take cognizance of other matters where the asperities of the common law required softening. Thus, in an ordinary mortgage, when the mortgagor had made default in payment of the principal sum due, the mortgagee was, according to the common law, entitled to the property held in mortgage for his own absolute benefit. Equity, on the other hand, declared that the mortgagee should only hold the property as security for the repayment of the sum due to him, and after recouping himself such sum, either by means of the rents and profits or by a sale, should restore the property or hand over the balance realized by the sale to the mortgagor. Again, in the matter of contracts, the common law could only a suitor for a breach of contract by giving him pecuniary

damages. But equity assisted him further by ordering a specific performance of the contract. For instance, A agreed to purchase Blackacre from B. If B refused to carry out the purchase, A's remedy at law was by an action to recover a sum of money as a solace for the broken agreement; but in equity A might ask for and obtain a decree compelling B to perform the contract. The judges of the common law courts did not submit to this interference without many and fierce struggles, which came to a climax in the contest between Lord Chancellor Ellesmere and Sir Edward Coke, Lord Chief Justice of England. The matter was referred to James I., who decided in favour of the Court of Chancery, and from that time its jurisdiction was never seriously questioned.

Fusion of Common Law and Equity.—As the power and practice of equity became more recognised and defined, it drifted farther away from the common law. Harassed suitors were driven from one to the other in a wild search for justice, as in many instances it was impossible for either court to give complete satisfaction. Several attempts were made to improve matters. By legislative enactments legal powers were given to the courts of equity, and equitable jurisdiction to the courts of common law. All anomalies and conflicts were at length put an end to in 1873 and 1875 by the "Supreme Court of Judicature Acts." These two important statutes entirely reconstructed the Courts of Justice, and declared that all the courts should give relief upon equitable as well as upon legal principles, and that where a conflict arose equity should prevail.

V. THE ADMINISTRATION OF THE LAWS.

Justice is chiefly administered by **The Supreme Court of Judicature, The London Court of Bankruptcy, The Courts of Assize, The County Courts, The Courts of Quarter Sessions,** and **The Courts of Petty Sessions**; also by the following tribunals which have a local, a limited, or special jurisdic-

tion: **The County Palatine of Lancaster, The Stannaries Court, The Lord Mayor's Court, The Court of Commissioners as to Regulation of Railways, The Court of the Lord High Steward, The Archdeacon's Court, The Consistory Courts, The Court of Arches, The Courts Martial,** and **The Central Criminal Courts. The House of Lords** and **The Privy Council** also sit for the purpose of administering the Laws.

The Supreme Court of Judicature consists of two permanent Divisions, **Her Majesty's High Court of Justice,** and **Her Majesty's Court of Appeal.**

The High Court of Justice is constituted as follows: The Lord Chief Justice of England, and nineteen Puisne Justices, styled "Judges of Her Majesty's High Court of Justice." The judges of this court have in all respects equal power, authority, and jurisdiction. For the more convenient despatch of business, this court consists of three Divisions; namely **The Chancery Division, The Queen's Bench Division,** and **The Probate, Divorce, and Admiralty Division.** It is to be observed that two or three of the judges of this court still retain the titles which they held before 1875, but these will become extinct as the present holders relinquish their office, and their successors will become "Judges of Her Majesty's High Court of Justice."

THE CHANCERY DIVISION.—Five of the judges of the High Court of Justice sit to dispose of the business brought before this Division. To it are assigned the following kinds of causes: The administration of the estates of deceased persons; the dissolution of partnerships or other accounts; the redemption or foreclosure of mortgages; the raising of portions or other charges on land; the sale and distribution of the proceeds of property, subject to any lien or charge; the execution of all trusts, charitable and private; the rectification, or setting aside, or cancellation of deeds or other written documents; the specific performance of contracts between vendors and purchasers of real estates, including contracts for leases; the

partition or sale of real estates; the wardship of infants and the care of infants' estates. Each of the five judges attached to this Division sits as a separate court, and decides all matters of fact as well as of law. In the work of administering the estates of deceased persons and of executing trusts, the Judges are greatly assisted by their Chief Clerks, whose duties are to carry out the orders of the Judges as to making inquiries in the various matters, and to report thereon. This Division would seem at first sight, from the nature of the business assigned to it, to be the old High Court of Chancery. This is not so; it is a part of the High Court of Justice, and has no more power or authority than another Division. It determines the matters brought before it, and cannot interfere with the decrees made by another Division. There is no confusion, no denial of justice. Litigants are no longer in doubt as to where to bring their actions; these, they know, must be brought in the High Court of Justice, and they also know that there is no other court which can step in and restrain them from continuing their proceedings, or from reaping the benefits of the decrees which they have obtained, simply because they have had recourse to a wrong tribunal. Even where they have set down their actions for hearing before a Division which does not entertain, as part of its business, the matters in complaint, an order will at once remove them into their right Division, and the litigants are not exposed, as they formerly were, to the annoyance and expense of seeing all their proceedings quashed, and themselves compelled to begin again. It is useful to add that the judges attached to one Division may, and in practice frequently do, sit in another Division. This Division hears and determines all appeals from the County Courts relating to those matters mentioned above, and assigned to it.

THE QUEEN'S BENCH DIVISION.—The Lord Chief Justice of England and eleven judges of the High Court of Justice usually sit in this Division. To it are assigned all matters, civil and criminal, which formerly came within the cognisance of the old courts of Queen's Bench, Common Pleas,

and Exchequer, the old courts of Common Law. Actions of every kind, except those specially assigned to the two other Divisions, are determined in this Division. It is the Superior Criminal Court in the kingdom, and criminal proceedings can only be removed into it from inferior courts. To this Division are made all applications for writs of Quo Warranto, Habeas Corpus, Mandamus, and Prohibition. It is a Court of Appeal from the County Courts (in matters other than those brought before the Chancery Division), the Lord Mayor's Court, the Courts of Quarter Sessions, the courts for the revision of the lists of persons entitled to vote at the election of the House of Commons; and it hears all petitions relating to the validity of Parliamentary elections. The judges sit separately, either with or without a jury, to determine all causes set down in this Division. From their judgment an appeal may be brought in the same Division sitting in Banc. Two or more of the judges sit together in Banc to hear these appeals, and also appeals from the Courts of Assize, and from the inferior courts above mentioned. From the court sitting in Banc, there is no further appeal in the last-named cases except by leave of the court. In criminal cases, the decision of the court sitting in Banc is final. In important criminal cases where the judges differ in opinion, the matter is reheard, sometimes by the whole of the judges of the High Court of Justice.

THE PROBATE, DIVORCE, AND ADMIRALTY DIVISION.—Two of the judges of the High Court of Justice sit in this Division. The senior of them is styled the President. To this Division are assigned all matters connected with the due attestation and execution of wills, and their validity, and with the grant of probate and of letters of administration; but it is not the business of this Division in any way to interpret the meaning of the wills themselves. It also hears and determines all cases in which the legality of marriages is disputed, and all applications for divorce and judicial separation. Claims for salvage, towage, and other claims relating to ships and shipping,

and appeals in such matters from those County Courts which have a jurisdiction "in Admiralty" are adjudicated upon in this Division. The old Court of Admiralty is merged in this Division. The judge is assisted by assessors, who are usually officers of the Royal Navy or Merchant Service.

THE COURT OF APPEAL.—This court, with the High Court of Justice, constitutes the Supreme Court of Judicature. There are six judges attached to the Court of Appeal, one of whom is styled the Master of the Rolls, and the other five are called Justices of Appeal. The Lord Chancellor, the Lord Chief Justice of England, and the senior justice attached to the Probate, Divorce, and Admiralty Division of the High Court of Justice, are *ex-officio* members of the Court of Appeal, and sit there from time to time as occasion requires. Three members usually sit to hear appeals which may be brought from the three Divisions of the High Court of Justice in cases which came originally before them, and to hear by way of further appeal cases which have been brought from the inferior courts to the Chancery and Queen's Bench Divisions, but only where leave to further appeal has been granted; and to hear by way of further appeal cases decided by the Chief Judge in Bankruptcy. The Court of Appeal has original and exclusive jurisdiction in lunacy. In this latter capacity it disposes of all matters connected with the custody and property of lunatics.

THE COURTS OF ASSIZE.—At stated periods in the year the Sovereign issues a number of commissions to the judges of the Supreme Court of Judicature to go into various cities and towns in England and Wales, to hear and determine all civil causes which have been set down for trial elsewhere than in London, and to try all prisoners who have been committed for trial by the Courts of Petty Sessions. The courts so held are called Courts of Assize. The commissioners travel to the cities and towns named in the commissions, and there try, with the assistance of juries summoned by the sheriffs, all prisoners who are in the gaol. They are bound to so try every prisoner, and to make a clear "gaol delivery." They also hear all civil causes

in the same manner as the justices of the High Court of Justice do when sitting at the Royal Courts, London. The cases triable at the Courts of Assise are those which may be assigned to the Queen's Bench Division of the High Court of Justice only.

THE COUNTY COURTS.—In order to lessen the costs of litigation, and to bring justice closer to suitors' doors, England and Wales have been divided into a number of circuits or districts, in each of which is a court of law, presided over by a judge appointed from barristers of at least ten years' standing. These courts are the County Courts, and the judges are styled judges of County Courts. They have jurisdiction in all matters assigned to the Chancery Division of the High Court of Justice, where the claims in question do not exceed £500 in amount; in all matters assigned to the Queen's Bench Division (except in actions for breach of promise of marriage, malicious prosecution, libel, slander, and seduction), where the claims do not exceed £50 in amount; and in all matters assigned to the Probate, Divorce, and Admiralty Division, except matrimonial causes, where the claims do not exceed £500 in amount. The County Courts cannot entertain any matters relating to the criminal law; in actions of ejectment, where the title to lands and houses is in dispute, and the yearly value of the same exceeds £20, they have no jurisdiction. In bankruptcy, the power of the County Courts is co-extensive with that of the London Court of Bankruptcy. Under certain statutes, all matters must be brought before the County Courts, independent of the amounts of the claims in question. Such statutes are: The Employers' Liability Act, the Friendly Societies' Act, the Married Women's Property Act, etc.

THE COURTS OF QUARTER SESSIONS.—These courts are held before two or more justices of the peace four times in every year, for the purpose of trying prisoners who have been committed for trial by the Courts of Petty Sessions. Prisoners, however, committed for any of the following among other

offences cannot be tried by these courts, but only at the Assizes or Central Criminal Court: treason, murder, manslaughter, forgery, bigamy, perjury, blasphemy, libel, etc. The Courts of Quarter Sessions also sit as a Court of Appeal from the decisions of the Courts of Petty Sessions, in those cases where an appeal is allowed. The decisions of the Courts of Quarter Sessions may be reviewed by the Queen's Bench Division of the High Court of Justice. It is well to observe that, as the law at present stands, there is no appeal from either the Courts of Assize or Quarter Sessions in criminal matters on questions of fact, but only on points of law.

THE COURTS OF PETTY SESSIONS.—In cities, boroughs, and towns corporate, justices sit every day for the purpose of inquiring into offences committed by persons who have been arrested, and to hear summonses taken out under various enactments relating to breaches of the peace, the licensing laws, the collection of rates, the sanitary laws, etc. In many cities and boroughs these duties are performed by a justice of the peace appointed from among barristers of not less than ten years' standing, and styled a stipendiary magistrate. Every sitting of the justices or stipendiary magistrate is a Petty Sessions. In those cases where the justices have power to deal with an offender, they settle the matter by inflicting a fine or a term of imprisonment; otherwise, they commit him to take his trial either at Courts of Assize or Quarter Sessions.

THE PALATINE COURT OF LANCASTER.—This is a local court of high jurisdiction. It is nominally presided over by the Chancellor of the Duchy of Lancaster, but the duties are actually performed by a barrister of high repute, who is styled the Vice-Chancellor. All causes which are assigned to the Chancery Division of the High Court of Justice, and arise in Lancashire, may be brought before this court. The Vice-Chancellor sits at Liverpool and Manchester during several weeks in the year to hear such causes. An appeal lies from this court to the Court of Appeal.

THE STANNARIES COURT.—This court has exercised a peculiar jurisdiction from a very early period. It takes cognisance of all suits between miners in Devonshire and Cornwall. It is presided over by a judge, who is styled the Vice-Warden of the Stannaries. An appeal lies from his decisions to the Court of Appeal. The privileges of the miners in the two counties were confirmed by a statute passed in the reign of Edward I.

THE LONDON COURT OF BANKRUPTCY.—This is still a separate court, and does not form a part of the High Court of Justice. It is presided over by a Chief Judge and a certain number of registrars, who sit separately as judges, and for the Chief Judge. All matters relating to the property of persons who are unable to meet their engagements, and are desirous of making some arrangement with their creditors, or who have been adjudicated bankrupts on the petition of one or more of their creditors, are brought before this court from all parts of England and Wales. The County Courts have a concurrent jurisdiction with the London Court of Bankruptcy, and insolvents or creditors may elect to go to the County Court or to the London Court of Bankruptcy. An appeal from the decisions of the Chief Judge may be made to the Court of Appeal of the Supreme Court of Judicature. Appeals from the County Courts in bankruptcy go to the Chief Judge in the first place.

THE LORD MAYOR'S COURT.—This is a court exercising a jurisdiction unlimited as to amount within the city of London, in all causes arising within the city, both at common law and in equity. It is presided over by the Recorder of London, and has the power of attaching money due to a defendant by his debtor, so as to render it available to satisfy the plaintiff's claim. This is done by a process called *foreign attachment*. An appeal lies from the Lord Mayor's Court to the Queen's Bench Division of the High Court of Justice in common law matters, and to the Chancery Division in equity causes.

COMMISSIONERS OF RAILWAYS.—By the Regulation of Railways Act, 1873, power is given to the Crown to appoint three persons to sit as commissioners to hear and determine all matters in dispute relating to the regulation of traffic, rates, charges, etc., on railways and canals. The commissioners exercise all the powers of the ordinary courts, and from their decisions an appeal will lie to the High Court of Justice.

THE COURT OF THE LORD HIGH STEWARD.—This is a court called together by the Lord High Steward, who is appointed for the purpose, for the trial of peers indicted for treason or felony. The trial takes place before the peers, and the verdict is that of the majority.

THE ARCHDEACON'S COURT.—This court has jurisdiction in ecclesiastical matters touching the Established Church of England. It is presided over by the archdeacon, or, in his absence, by a judge appointed by himself. An appeal lies to the Bishop's Court. Like all the other ecclesiastical courts, its jurisdiction is confined to matters purely relating to the clergy of the Established Church.

THE CONSISTORY COURTS.—These are the Bishops' Courts, and are held by the bishops in their cathedrals for the trial of all ecclesiastical causes within their respective dioceses. Each court is presided over by the Bishop's Chancellor. From his judgment an appeal lies to the Archbishop's Court.

THE COURT OF ARCHES.—This is the court of the Archbishop of Canterbury, and is held at Westminster. The court is presided over by a judge, styled the Dean of Arches, who hears and determines all appeals from the inferior ecclesiastical courts. From his decisions an appeal lies to the Judicial Committee of the Privy Council.

THE COURTS MARTIAL.—These are purely military courts, and are convened for the trial of persons who are amenable to the Articles of War. The Articles of War are made by the Sovereign, and relate to the duties of soldiers and sailors. The courts consist of commissioned officers, who sit to try naval and military prisoners who have committed offences within the

scope of the Articles of War. There is no appeal from these courts except to the Sovereign.

THE CENTRAL CRIMINAL COURT.—This court was established in 1834 for the trial of murders, felonies, and misdemeanours committed within the city of London, the county of Middlesex, and certain places in Essex, Kent, and Surrey. The Queen's Bench Division has power to order for trial at this court prisoners charged with felonies and misdemeanours committed in any part of England or Wales. Such orders are made most frequently when, by reason of strong feeling against a prisoner in the county where the offence has been committed, he is not likely to have an impartial trial. The Lord Mayor of London, the Lord Chancellor, the judges of the Supreme Court of Judicature, the Dean of Arches, and such others as the Crown may appoint, are the judges who may sit at the Central Criminal Court. The prisoners are tried as at the Courts of Assize.

THE HOUSE OF LORDS.—This is the Supreme Court of Judicature in the kingdom in all civil matters. It is composed of the peers of the realm, and hears all appeals from the Court of Appeal, and the highest courts of justice in Scotland and Ireland. It has no jurisdiction in criminal or ecclesiastical matters. As a court of law, the peers who usually sit in the House of Lords are those who have held or do hold some high legal office, and three life-peers, styled Lords of Appeal. In hearing and determining causes brought before them, these peers may call in the assistance of all the judges of the High Court of Justice. This they do by presenting a written statement with questions appended, to which those judges return written answers.

THE JUDICIAL COMMITTEE OF THE PRIVY COUNCIL.—This is a court formed by members of the Sovereign's Privy Council, and sits to hear appeals to the Sovereign in Council. Such appeals are brought from the Court of Arches, the highest courts of justice of the Isle of Man, the Channel Islands, the Colonies, and India. The President of the court, after counsel has been heard, states the opinion of the whole or

the majority of the members, and concludes by saying that the court will advise the Sovereign either to affirm or reverse the decision.

TRIAL BY JURY.—This is an ancient institution, much valued by Englishmen as one of the greatest safeguards of personal liberty. Blackstone says, "Trial by jury ever has been, and I trust ever will be, looked upon as the glory of the English law. It is the most transcendent privilege which any subject can enjoy or wish for, that he cannot be affected either in his property, his liberty, or his person, but by the unanimous consent of twelve of his neighbours and equals. . . . A competent number of sensible and upright jurymen, chosen by lot from among those of the middle rank, will be found the best investigators of truth, and the surest guardians of public justice." This admirable institution is well adapted for securing impartiality and defending the subject against the oppression of the Sovereign and servile magistrates and judges. It enables the latter to act in a thoroughly impartial and independent manner, since it secures the co-operation of the citizens of a free country in the equal administration of justice without fear or favour. We have a striking example of the value of trial by jury in the reign of James II. At the famous trial of the seven Bishops, the influence of the King (though he was unpopular) was sufficient to secure the adherence of two out of the four judges; but it was powerless to govern the opinions of the jury, who returned a verdict of not guilty in defiance of the well-known wishes of the court. The origin of trial by jury is doubtful, since its early history can be carried back to Norman and Saxon times without any clear traces of its establishment being found. It probably arose gradually from the custom of referring points in dispute to the judgment of a certain number of persons living in the neighbourhood of the contending parties. Under the modern form of the system, a prisoner is tried by twelve men, chosen from respectable householders living in the neighbourhood of the Court, who are *sworn* to try the cause according to the laws and

the evidence brought before them. Hence they are called *jurymen* (Lat. *juro*, I swear), and the whole body is called the *jury*. There are three kinds of juries :—

(*a*) **A Grand Jury**, which consists of from twelve to twenty-three jurymen who hold a preliminary investigation into the criminal cases brought before the quarter sessions or the assizes, in order to decide whether a prisoner shall be tried at all. They examine the evidence *against* each prisoner ; if they find it of a trivial kind, the latter is at once discharged. If they decide that the evidence is of sufficient weight to justify the trial of the prisoner, they are said to "bring in a *true bill*" against him, and the case is proceeded with in the ordinary way before the common jury.

(*b*) **A Common Jury**, or **Petty Jury**, consists of twelve men, freeholders or ratepayers, chosen to try prisoners or decide in civil causes. A prisoner is allowed to object to or *challenge* any of the jury within certain limits. Jurymen thus objected to are replaced by others. It is not often that a prisoner exercises this right, which is given to him as a protection against the possibility of injustice which might arise from his being tried by a jury containing any person having a bias against him.

(*c*) **A Special Jury** is composed of men in a somewhat higher station of life, who are sometimes selected, at the option of the contending parties, to try cases of more than ordinary importance.

A prisoner, or either of the parties engaged in a civil action, may either conduct his own cause or employ an advocate, or *counsel*, for that purpose.

In a civil action the party prosecuting is called the *plaintiff*, he against whom the action is brought is called the *defendant*.

The following is the ordinary **mode of procedure** with respect to a prisoner tried at the assizes after he has been *committed for trial* by the magistrates. We will suppose that he is defended by counsel.

The court is presided over by the **Judge**, who controls the whole proceedings, and sees that they are conducted in accord-

ance with the laws. The prisoner having been brought forward, and the judge and jury taken their seats, the latter are **sworn**, that is, each juryman takes an oath to decide the case according to the laws and the evidence. The jury choose one of their number to be their *foreman*, or spokesman.

The **counsel for the prosecution** commences the trial by a speech, in which he gives a general summary of the case, and of the evidence which he is about to produce in support of the charge brought against the prisoner.

Then follow the **witnesses**, who appear against the prisoner and give evidence tending to convict him. Each witness first takes an oath that the evidence he is about to give "shall be the truth, the whole truth, and nothing but the truth," and kisses the New Testament in confirmation of its validity. Quakers and some other persons are allowed to make an *affirmation* instead of taking an oath. The evidence of each witness is elicited by questions from the prosecuting counsel and sometimes from the judge. The counsel for the defence *cross-examines* each witness in order to shake his evidence by causing him to stumble into difficulties or contradict himself.

The **counsel for the defence** then makes a speech, giving a summary of the case for the prisoner, and proceeds to call evidence in his favour. Each witness for the defence is examined by the counsel pleading the cause of the prisoner, and cross-examined by the counsel for the prosecution. The judge puts a question now and then when he deems it necessary in order to elicit the truth. The prisoner is not allowed to give evidence, but is sometimes permitted to make a statement.

Next follows a speech from the **counsel for the prisoner**, placing the case of the latter in the most favourable light before the jury.

The opposite counsel then addresses the jury in like manner in support of the prosecution.

The judge then **sums up the evidence** on both sides, presenting it in a fair and legal form as clearly as possible before the jury, in order to assist them in coming to a just conclusion.

The jury then give their **verdict**, through the foreman, in the words "Guilty" or "Not Guilty." The verdict must be unanimous. Sometimes the jury decide without leaving their box; at other times they retire in order to deliberate before giving a verdict. If it should happen that they cannot possibly agree on a verdict, they are discharged, and a new trial has to be held.

If the jury give a verdict of "Not Guilty," the prisoner is discharged. If the verdict be "Guilty," the judge pronounces sentence, according to the nature of the crime and the laws which relate to it. If the prisoner be convicted of murder, the judge puts on the black cap, and pronounces sentence of death. The prisoner is then removed in custody of the jailors, and the trial is at an end.

VI. MISCELLANEOUS.

POLITICAL PARTIES. The members of the two houses are divided into bodies holding similar views with regard to the great political questions of the day. The greater part of the members belongs to two of these bodies, or parties, as they are called. These two great political parties are :—

(1) **Whigs**, or **Liberals.** The latter is the more modern name. The origin of the term *whig* is doubtful. It is said to be derived from a word, *whiggam*, formerly used by Scotch peasants in driving their horses; hence they were called *whiggamores*, or *whiggs*. It was applied derisively to the political party in the 17th century. The Liberals are the party of progress; they are inclined to democratic institutions, and are supposed to be much more favourable to changes in the Constitution than their opponents.

(2) **Tories**, or **Conservatives.** The latter is the more modern name. *Tory* is also a word of doubtful origin. It is said to be derived from an Irish word meaning a *robber*. Its use as a political term dates also from the 17th century. This party represents the cause of order and the maintenance of the

Constitution. It is opposed to democratic institutions, and is supposed to be generally unfavourable to change, being disposed, as far as possible, to preserve the present order of things, and maintain existing institutions. It is especially regarded as supporting the present connection between Church and State.

The Executive Government is usually chosen from one of these two great parties. Each has its recognised leaders in both houses of Parliament; and the one which has the support of the country, and can command a majority of the House of Commons, is called upon to undertake the government of the kingdom. The party which is in office is called the Ministerial party; the other is called the Opposition. When the Ministers lose the confidence of the House of Commons, which is shown by a majority of votes against them on some important matter, they are bound by usage either to resign in favour of their rivals, or to dissolve Parliament and *appeal to the country*. If they resign, the Sovereign calls upon the chief of the Opposition to form a Ministry, and the two parties change positions, since the former Ministerial party now becomes the Opposition, and *vice versâ*. It is the custom for the party which is in office to sit on the right hand of the Speaker, and for the Opposition to sit on his left.

There is another important political party called the **Radicals**. They are sometimes regarded as belonging to the Liberal party. They represent democratic views, and are supposed to be in favour of more violent and extensive changes in the Constitution than the moderate Liberals. Members of this party are sometimes appointed to offices in Liberal governments; but it has never yet been sufficiently powerful to undertake the government of the country by itself.

Other parties are sometimes formed for special objects, and often give much trouble to the Government by voting against it when they cannot attain their ends. The most important of these is the Irish National party, which has had various names at different periods, and is now called the **Home Rule Party**.

There are also **Independent members,** who belong to no political party, and give their votes according to circumstances.

PETITIONS. Subjects have the right of presenting petitions to either house of Parliament either in favour of or against any particular measure. Such petitions must be signed by the persons who send it, be drawn up in accordance with certain rules, and be presented through a member of the house to which it is addressed.

DEPUTATIONS. It is also customary for Ministers and private members to receive deputations from bodies of persons who wish to impress their views on those in authority. Such deputations are generally received either in rooms connected with the Houses of Parliament, or at the official residences of the Ministers.

THE THREE ESTATES. This is a name given to the different orders or branches of the British Government. The term "Estates of the Realm" is now generally applied to the King, Lords, and Commons, though it is sometimes held to denote only the Lords and Commons.

FREEDOM OF THE PRESS. The liberty allowed to the newspapers and other periodical publications of publishing the parliamentary debates, disseminating information, discussing public affairs, and criticizing the action of the Government, is justly regarded as one of the strongest safeguards of national freedom. Hence the Press has even been called the "Fourth Estate" of the realm. Many contests were carried on between the supporters of arbitrary rule on the one hand and the champions of liberty on the other before the present right of unlicensed printing was fully established. While, however, the Press is allowed the liberty of commenting on public affairs in the freest manner, the law of libel protects private individuals from being made the objects of *false* and *malicious* attacks in newspapers and other publications.

TAXES. As already stated, taxes levied for the purpose of defraying the expenses of the Government are under the control of the House of Commons. This arrangement is based on the political maxim that "Taxation and representation are inseparably united." (*See* Answer to Examination Question No. 21, page 196.) The student of English history will have observed the extreme importance which our forefathers attached to establishing the doctrine that Englishmen are not to be taxed without their own consent, given through their representatives in Parliament. Numberless contests have arisen between the Crown and the people on this point. Our colonists in America, taking the same ground, resisted the attempt of the mother country to tax them without their own consent, and hence arose the American War of Independence, which resulted in the separation of the colonies from the British Empire.

Taxation is of two kinds :—

(1) **Direct Taxes**, as—

(*a*) *The Income Tax*, levied on private incomes, at a certain rate per £; when payable in respect of income and profits derived from land and houses, it is called *Property Tax.*

(*b*) *Land Tax*, levied on land-owners, according to the value of their estates.

(*c*) *Inhabited House Duty*, depending on the rental value of the houses.

(2) **Indirect Taxes**, as—

(*a*) *Customs*, or duties imposed on exports or imports.

(*b*) *Excise*, or inland duties laid on goods in the hands of merchants and retail dealers before being delivered to the consumers ; licenses on dogs, to carry firearms, sell tobacco, etc., etc.

(*c*) *Stamps*, on conveyances, mortgages, leases, etc.

(*d*) *Post Office and Telegraph Receipts.*

PRIME MINISTERS OF ENGLAND FROM THE ACCESSION OF GEORGE III.

The following list may be useful for reference. The dates denote the years in which each administration took office.

GEORGE III.

1.	Mr. William Pitt (afterwards Earl of Chatham)	June, 1757.
2.	Earl of Bute	Oct., 1761.
3.	Mr. George Grenville	April, 1763.
4.	Marquis of Rockingham	July, 1765.
5.	Earl of Chatham (William Pitt)	July, 1766.
6.	Duke of Grafton	Oct., 1768.
7.	Lord North	Jan., 1770.
8.	Marquis of Rockingham	Mar., 1782.
9.	Earl of Shelburne	July, 1782.
10.	Duke of Portland (Coalition Ministry)	April, 1783.
11.	Mr. William Pitt (son of the Earl of Chatham)	Dec., 1783.
12.	Mr. Henry Addington	Mar., 1801.
13.	Mr. William Pitt	May, 1804.
14.	Lord Grenville (Ministry of all the Talents)	Feb., 1806.
15.	Duke of Portland	Mar., 1807.
16.	Mr. Spencer Perceval (assassinated)	Oct., 1809.
17.	Earl of Liverpool	May, 1812.

GEORGE IV.

1.	Mr. George Canning	April, 1827.
2.	Viscount Goderich	Sept., 1827.
3.	Duke of Wellington	Jan., 1828.

WILLIAM IV.

1.	Earl Grey	Nov., 1830.
2.	Viscount Melbourne	July, 1834.
3.	Sir Robert Peel	Dec., 1834.
4.	Viscount Melbourne	April, 1835.

VICTORIA.

1.	Sir Robert Peel	Sept., 1841.
2.	Lord John (afterwards Earl) Russell . .	July, 1846.
3.	Earl of Derby	Feb., 1852.
4.	Earl of Aberdeen	Dec., 1852.
5.	Lord Palmerston	Feb., 1855.
6.	Earl of Derby	Feb., 1858.
7.	Lord Palmerston	June, 1859.
8.	Earl Russell	Nov., 1865.
9.	Earl of Derby	July, 1866.
10.	Mr. Benjamin Disraeli (afterwards Earl of Beaconsfield)	Feb., 1868.
11.	Mr. William Ewart Gladstone . . .	Dec., 1868.
12.	Mr. Benjamin Disraeli (Earl of Beaconsfield)	Feb., 1874.
13.	Mr. William Ewart Gladstone . . .	April, 1880.

QUESTIONS FOR EXAMINATION.

The following questions are selected from previous Examination Papers. Occasional answers are given.

(1) Describe the conquest of England by the Normans, and some of the institutions introduced by them.

(2) Sketch the character of the sovereign whose history has most deeply interested you.

(3) How and when were Wales, Scotland, and Ireland united with England?

(4) How are laws made in the United Kingdom?

(5) What form of government is established in this country? How does it differ from other forms of government which you can name?

(6) Compare the England of Elizabeth with the England of Victoria.

(7) How did the parliaments which met in 1660 and 1689 differ from ordinary parliaments? Give some account of the acts of one of them.

(8) Point out, as to an upper class of children, the benefits

of possessing an acquaintance with the history of our own country.

(9) Explain, as to an upper class of children, the composition of the British Parliament.

(10) What was the Indian revolt? To what change in the government of India did it lead?

(11) What is trial by jury? Do you consider the institution beneficial, and in what respect?

(12) Give the names and dates of any Princes of Wales who did not succeed to the English throne, and write a short account of one of them.

(13) Write a short history of one of the following:—Horatio Nelson, William Pitt, Robert Clive, Joseph Addison.

(14) Which of the sovereigns of England approaches nearest to your idea of a perfect ruler of the people? Give reasons for your opinion.

(15) Give the full names of three celebrated persons of the time of Elizabeth, and tell briefly what you know about them.

(16) Who is the present Prime Minister? What can you tell about the office which he holds?

(17) Set down a list of the civil wars which have raged in this country, with dates; and briefly describe the cause and event of *one* of them.

(18) Compare the effects of the subjugation of Britain by the Romans and the conquest of England by the Normans.

(19) Mention some inventions unknown to William the Conqueror which increase the convenience of our daily life.

(20) Describe the causes and consequences of the Battle of Algiers (1810).

(21) "Taxation and representation are inseparably united." Give instances, local and national, in which this maxim is acted on.

(*a*) The power of levying taxes, and making grants of public money for purposes of war and the public service generally, is vested in the House of Commons, which is composed of the representatives of the people, who pay the taxes. The Chancellor

of the Exchequer, who has command of the national revenues, must be a member of the House of Commons. The House of Lords, which is not chosen by the people, has no control over the revenues raised by taxation.

(*b*) Members of corporations of towns, local boards, and guardians of the poor, who have the power of levying rates for various local purposes, such as the relief of the poor, elementary education, the maintenance of the police, and the supply of water, are all elected by the ratepayers.

(*c*) Our colonists are subjects of the Queen equally with ourselves; but since they are not represented in the British Parliament, they are not required to contribute to the Imperial Treasury. They are taxed by their own colonial assemblies, to which they send representatives.

(*d*) This principle is also acted on even in the case of private institutions, such as hospitals, schools, asylums, etc., supported by voluntary contributions. These are governed by committees, or bodies of managers, chosen by the individuals who contribute to the maintenance of each institution, and who represent the subscribers.

(22) What was Poynings' Law of 1495? Explain its object.

Poynings' Law, or the Statute of Drogheda, was a famous Act, passed chiefly through the agency of Sir Edward Poynings, Lord Deputy of Ireland, in the reign of Henry VII. Its object was to establish the authority of the English Government in Ireland. The Irish had been in an almost constant state of disaffection for many years. Frequent rebellions had taken place, and the insurrections of Simnel and Warbeck had received great support from Ireland. These cases, in addition to the fact that the Irish had generally favoured the cause of the House of York, made Henry VII. desirous of bringing Ireland under entire subjection to England.

The chief provisions of this statute were :—(1) That all laws lately passed in Ireland should be of force in Ireland. (This clause was held to refer to all statutes passed prior to this

enactment). (2) That no parliament should be held in Ireland without the consent of the king and his council, and that any parliament convened without the royal licence should be held null and void.

It contained various other provisions for checking the lawlessness of the Irish, and especially that of the English colonists in Ireland, who were animated by a desire of maintaining a kind of independence of the English Government, in which they were frequently assisted by the ambition of the lords-deputies.

The statute was, on the whole, effectual, and had great influence in maintaining the authority of the English Government over the native Irish, and still more over the lords-deputies of the Anglo-Irish.

(23) Give instances from our early history in which the principle of primogeniture was not followed in the succession to the throne.

(24) When and where did Napoleon I. die? Explain how he came to be there.

(25) Describe events which made the first five-and-twenty years of George III.'s reign an unfortunate era in our history.

(26) How would you explain the circumstance that while Scotland has a history independent of England down to the beginning of the 18th century, the same cannot be said of Ireland?

(27) "Rodney, Howe, Duncan, and Nelson, made their country mistress of the sea." Give dates and particulars of their principal achievements.

(28) At what broad periods of our history has this island fallen under the influence of Scandinavia, Germany, Holland, France, and Spain respectively?

(29) Give the names and dates of any sovereigns of this country since 1060 who may be considered as usurpers, and in each case mention the name and title of the person having better claims to the throne.

(30) Who were Arthur, Prince of Wales, 1502; Henry, Prince of Wales, 1612; and Frederick, Prince of Wales, 1750?

ENGLISH GRAMMAR.

SOURCES, GROWTH, HISTORY, AND LITERATURE OF THE ENGLISH LANGUAGE.

I. ORIGIN OF THE ENGLISH LANGUAGE.

The countries of Europe have been peopled by races who came originally from Asia. Most of those countries now contain inhabitants descended from the **Indo-European**, or **Aryan** family, which had its original seat north of the Himalaya Mountains.

The various branches of the Indo-European family speak languages derived from the same source, and therefore resembling each other to a greater or less degree, according to various circumstances which have caused them to deviate less or more from the original and common language. English is one of the modern Indo-European languages.

The ancestors of the modern Indo-European races introduced themselves into Europe in three great waves of migration, representing three principal offshoots from the same root.

(1) **The Celtic**, or **Keltic**, who settled in Gaul, Germany, Italy, Spain, and the British Islands. The Celts were gradually driven farther west by the Teutonic tribes and the Greeks and the Italians, all of whom spring from the same stock.

The Celtic dialects now spoken in Europe are Welsh, Irish, Gaelic (in the Highlands of Scotland), Manx (in the Isle of Man), Bas Breton (in Brittany).

(2) **The Gothic**, or **Teutonic**, who first settled in the centre and north of Europe and gradually extended themselves farther west and south.

The English, Dutch, German, Danish, Swedish and Norwegian languages are derived from this source.

(3) **The Slavonic**, who settled in the eastern and north-eastern portion of Europe.

The Russian, Polish, and Bohemian languages are derived from this source.

The South of Europe was settled by tribes of Pelasgians (sea-farers) who belonged to the same original family, and took possession of Greece and Spain.

From this source are derived the Ancient Greek, Modern Greek, Latin, Italian, French, Spanish, Portuguese, Roumanian, and Wallachian languages.

The present English language, as before observed, belongs to the Teutonic group. It was introduced into this country by the Saxon tribes who conquered England during the fifth and succeeding centuries. They consisted of the Jutes, Saxons proper, and Angles (from whom the name England, that is, Angle-land, is derived). It will not be necessary here to relate the particulars of this Saxon occupation of the country. We must refer the pupil to the full account which has been already given of it in the English History contained in "The Pupil Teacher's Course." It will be sufficient to add, that the Saxons succeeded in driving out the Celtic inhabitants from the greater part of the country, and establishing their own religion, customs, and language instead of those they supplanted.

Thus, till the fifth century after Christ, the Celtic dialect prevailed in this country, but during that and the succeeding centuries it was superseded by the Saxon (a branch of the Teutonic) which took deep root in the country, and now forms the foundation of our modern English language.

II. ELEMENTS OF WHICH THE ENGLISH LANGUAGE IS COMPOSED.

It has been already shown that the English language is, in the main, Saxon, and therefore Teutonic. The *grammar* of the

English language is almost entirely derived from the Saxon, but a large number of *words* have been introduced from some other stock. The chief sources of English words may be thus classified.

(1) **SAXON, or ANGLO-SAXON.** Most of the ordinary English words are Saxon. It has been calculated that about 60 per cent. (sixty out of every hundred) of those words in the English language are from this source. Nearly all familiar words are Saxon, such as *day*, *night*, *earth*, *body*, *ox*, *sheep*, *fox*, *ask*, *drink*, *head*, *heart*, *father*, *mother*, *brother*, *sister*, *wife*. Our authorized translation of the Bible consists mainly of words of Saxon origin. In the Lord's Prayer, for example, consisting of sixty-nine words, only eight are derived from non-Saxon sources.

Modern English differs greatly from Anglo-Saxon. For example, there are two letters in the latter which are not found in the former, representing nearly the two sounds of *th* (in *thin*, and *that*).

The Anglo-Saxon language contained more inflections than the English of the present day. The latter, like other modern languages, has dropped a great many of the ancient inflections, and uses auxiliary verbs, prepositions, and other particles in their stead. We here give examples of the difference in this respect between Anglo-Saxon and Modern English.

(*a*) The English noun only admits of two inflections; one to denote possessive case, and the other to express the plural number. Thus, we have *day*, pl. *days*, poss. *day's*, *days'*.

The Anglo-Saxon word *dæg* was inflected thus :—

SING.		PLURAL.
Nominative } *Accusative* }	dæg	dagas
Dative	dæge	dagum
Genitive	dæges	daga.

(*b*) The English adjective has no inflection. We say, *a good man*, *a good woman*, *a good house*, *good men*, *good women*, *good*

houses, where the adjective remains the same for singular and plural, and for masculine, feminine, and neuter. In Anglo-Saxon, however, the adjective was fully declined for number, gender, and case. For example, *god*, good, was thus declined, with the noun it qualified :—

	SINGULAR.			PLURAL.
	Masc.	*Fem.*	*Neut.*	*M. F. N.*
Nom.	god	god	god	gode
Acc.	godne	gode	god	gode
Dat.	godum	godre	godum	godum
Gen.	godes	godre	godes	godra.

This is called the *Strong Declension*. There was also a *Weak Declension* equally full, and applicable to the same adjectives under different circumstances, so that the inflections in Anglo-Saxon adjectives were very numerous.

The following is a list of Anglo-Saxon words from which English words are derived with little or no change. Others will be given further on. (The spelling is modernized.)

(*a*) NOUNS. Smith, ende (end), sunu (son), brothor (brother), dohtor (daughter), sweoster (sister), fæder (father), man, boc (book), cu (cow), gos (goose), mus (mouse), turf, word, treow (tree), leaf, land, wif (woman), steorra (star), tunge (tongue), eage (eye), bera (bear), cyning (king), gast (spirit, ghost), græs (grass), grund (ground), ham (home), steam, stream, theof (thief), ban (bone), bæc (back), bliss, breost (breast), cild (child), clif (cliff), deaw (dew), dic (ditch), bread (bread), brycg (bridge), geat (gate), gold, seolfor (silver), stan (stone), stæf (staff), east, west, north, suth, sawol (soul), deofol (devil).

(*b*) ADJECTIVES. God (good), eald (old), geong (young), soth (sooth, true), eall (all), seoc (sick), yfel (evil), lytel (little), strang (strong), halig (holy), manig (many), hwit (white), blæc (black), fea (few), heah (high), freo (free), lang (long), feorr (far), neah (near), an (one), twa, threo, feower, fif, six, seofen, eahta, nigon (nine), tin, endlufon (eleven), twelf, twentig (twenty), hundred, thusend, cwic (quick, alive), deore (dear), fæst (fast, firm), feawa (few), other.

(*c*) PRONOUNS. Ic (I), me, min (mine), we, us, ge (ye), eow (you), ower (your), he, hit (it), him (to him, Dat.), thæt (that), thes (this), thas (these), hwa (who?), hwæt (what?), hwæther (whether of the two), sum (some).

(*d*) VERBS. (Infinitives). Bindan, standan, beran (to bear), growan (grow), feallan (fall), cnawan (know), wepan (weep), flowan, growan, habban (have), gangan (go), slæpan (sleep), drincan, findan, springan, swimman, windan, helpan, cuman (come), gifan (give), ceosan (choose), fleogan (fly), lettan, (let, hinder), sendan, fyllan (fill), thencan (think), wyrcan (work), lufian (love), don (do).

Eom (am), beo (be), eart (art), is (is), wæs (was), wæron (were).

(*e*) ADVERBS. Her (here), thær (there), hwær (where), hider (hither), genoh (enough).

(*f*) PREPOSITIONS. Abutan (about), in, ofer (over), beforan (before), for, thurh (through), of, æfter, æt (at), behindan, fram (from), gemang (among), on, toweard, under, uppon, withinnan, withutan (without), andlang (along).

(*g*) CONJUNCTIONS. And, butan (but), eac (eke, also), gif (if), thæt (that).

The indefinite article *a, an* is derived from the Saxon *an* or *ane*, one.

The definite article was *se*, afterwards changed to *the*.

(2) **LATIN.** The English language contains a large number of words derived from Latin. It has been calculated that about 20 per cent. of the common words in the English language are of Latin origin. Thus, next to the Saxon, the Latin is the chief element in the formation of ordinary English words.

Latin derivations are generally longer and less connected with the common everyday life of the people than words of Saxon origin. Sometimes the same idea is expressed by two different words, the simple and commoner one being derived from the Saxon, and the longer and more unusual from the Latin. The following are examples:—

Saxon.	*Latin.*	*Saxon.*	*Latin.*
hold	contain.	heavenly	celestial.
hide	conceal.	earthly	terrestrial.
deep	profound.	kingly	regal.
gift	donation.	bodily	corporeal.
dwell	reside.	house	domicile.
deadly	mortal.	young	juvenile.
work	labour.	like	similar.

The words of Latin origin were introduced into the English chiefly at the following epochs :—

(*a*) **The Roman Conquest of Britain.** The Romans first invaded this country under Julius Cæsar, B.C. 55. After subduing it they held possession till A.D. 410. During their occupation of Britain, which was of a military character, they introduced the Latin language, laws, and institutions ; made roads, built towns, constructed camps, and introduced the arts of Roman civilization. The influence of the Roman conquest on the language was, however, small, owing to the temporary nature of the occupation, the want of sympathy between the conquerors and the conquered, and the subsequent Saxon conquest. The Latin element then introduced appears principally in the names of towns, roads, and military stations. Chester (*castra*, a camp), Gloucester, Winchester, Lincoln (*colonia*, a colony), Colchester, Pontefract (*pons*, a bridge), Bridport (*portus*, a port), Watling Street (*via strata*, a road, street), are examples.

(*b*) **The Conversion of the Saxons** to Christianity, brought about by the mission of Augustine, who was sent by Pope Gregory I., 597. The Latin words then introduced were chiefly of an ecclesiastical character, and connected with the services of the Church. The following are examples :—

Clerk (clericus), monk (monachus), mass (missa), saint (sanctus), charity (caritas), preach (prædicare).

Some of the words introduced were derived from Greek through the Latin, as :—Bishop (episcopus), apostle (apostolus), deacon (diaconus), priest (presbyter).

(*c*) **The Norman Conquest.** The Normans spoke the Norman-French language, which was derived almost entirely from Latin. They endeavoured to suppress the Saxon language, and establish their own in its stead. French was spoken at court, employed in drawing up and administering the laws, and introduced into the universities and schools. The Saxons, however, adhered to their own language, and the two systems existed side by side in the country for many years, French being used by the superior classes and Saxon by the lower orders. Gradually, however, the two races and the two languages became blended together. This union produced the English language which we now use, and which consists mainly of words of Saxon origin, and a considerable mixture of words derived from Latin and introduced by the Normans.

The relative positions of the Normans and Saxons shortly after the conquest are well illustrated in the names of domestic animals, and of the various kinds of flesh obtained from them. The Saxons were the servants, and reared these animals, which, therefore, retained their Saxon names, as, *pig*, *sheep*, *ox*, *bullock*, *calf*. The flesh of these animals when killed was eaten by the masters, who were Normans, hence the various kinds of meat received names derived from Norman-French, as *pork*, *mutton*, *beef*, *veal*.

(*d*) **The Revival of Learning,** commencing after the Wars of the Roses. Most of the works written by learned men were in Latin. The Latin classical authors were the great models of composition for several centuries. Latin grammars and even English grammars for the instruction of youths were written in Latin, which was the chief subject of study at the schools and universities. Hence a large number of Latin words were introduced from time to time into the ordinary language of the nation as education advanced and the writings of learned men became more familiar to the common people.

(3) **GREEK.** A considerable number of words of Greek origin have been introduced from time to time by learned men They are chiefly terms connected with the arts, science,

and literature. A full list of Latin and Greek words is given below.

(4) **CELTIC**, or **Keltic.** Many words derived from the language of the ancient Britons (which, as we have seen, was of Celtic origin) still survive. The following are examples :—

(*a*) COMMON WORDS. Bag, gown, pot, cabin, pail, rug, size, whip, wicket, flannel, bran, gruel, hog, barrow, smooth, soak, knock. (Some of these are doubtful.)

(*b*) NAMES OF PLACES. Aberdeen (*aber*, a mouth), Avon (*afon*, water), Ben Nevis, Penmaenmawr (*ben*, or *pen*, a mountain), Ilfracombe (*combe*, a valley), The Downs, Dumbarton (*dun*, a hill), Inchkeith (*inch*, an island), Ouse, Esk, Thames, Severn, Cheviot, Malvern, Mendip, Wight, Kent, Liverpool, Penzance.

(*c*) GAELIC WORDS of later introduction from the Highlands of Scotland. Plaid, slogan, whiskey, bog, brogue, clan, claymore, kilt, fillibeg.

(5) **SCANDINAVIAN**, or **NORSE.** The Danes, who came from Norway, Sweden, and Denmark, and held the country for some time (*See* History of England), introduced some words of Scandinavian origin. Their language was a branch of the Teutonic group, and closely allied to Saxon. The following are examples :—

Whitby (*by*, a town), Scafell (*fel*, a hill), Wansbeck (*beck*, a stream), Grimsthorpe (*thorp*, a village), Scarborough (*scar*, a rock), Langholm (*holm*, an island), Sheerness (*ness*, a headland), Milford (*fiord* = *firth*, an inlet).

(6) **OTHER SOURCES.** Intercourse with other nations in ancient and modern times has led to the introduction of words from other sources. The following are examples :—

(*a*) **French.** Bouquet, etiquette, éclat, depôt, ennui, envelope, naïve, penchant, toilette, soirée, trousseau, guillotine, encore, devoir, beau, battue, bayonet, grimace.

(*b*) **Italian.** Bandit (pl. banditti), brigand, fresco, soprano. conversazione, cupola, dilettante, cicerone, gazette, gondola,

grotto, harlequin, madrigal, opera, pantaloon, regatta, stanza, studio, tenor, virtuoso, andante, adagio (and other musical terms), incognito, cartoon, cameo, pianoforte, piazza.

(*c*) **Spanish.** Matadore, mulatto, armada, barricade, flotilla, peccadillo, don, duenna, alligator, cargo, sherry, verandah, javelin, creole, desperado, embargo, guitar, gala, negro.

(*d*) **Dutch.** Boom, yacht, schooner, skipper, sloop, and other nautical terms.

(*e*) **German.** Cobalt, nickel, iceberg, father-land, hand-book. Our Saxon words are allied to the German.

(*f*) **Hebrew.** Hallelujah, sabbath, seraph (pl. seraphim), cherub (pl. cherubim), manna, shibboleth, amen, ephod, jubilee.

(*g*) **Arabic.** Admiral, talisman, alchemy, algebra, caliph, carat, assassin, harem, minaret, chemistry, sofa, giraffe, monsoon, cipher, coffee, vizier, zero, zenith.

(*h*) **Persian.** Chess, turban, scimitar, orange, lilac, dervise, jackal, sash, sherbet.

(*i*) **Hindustani.** Calico, coolie, sepoy, suttee, palanquin, jungle, lac, calico, chintz.

(*k*) **Chinese.** Nankeen, tea, junk, gong.

(*l*) **Turkish.** Bey, divan, seraglio, tulip, janissary.

(*m*) **Malay.** Bamboo, orang-outang, sago.

(*n*) **Australasian.** Kangaroo, tattoo.

(*o*) **American Indian.** Canoe, maize, tomahawk, tobacco, potato, wigwam, yam, lama, pampas.

HYBRIDS. When a word is composed of elements derived from more than one language, it is called a hybrid. The following are examples :—

Eatable. The stem *eat* is Saxon, and the affix *able* is Latin (abilis).

Wondrous. The stem *wonder* is Saxon, and the affix *ous* is Latin (osus).

Forbearance. The stem *forbear* is Saxon, and the affix *ance* is Latin (antia).

Atonement. The stem *atone* is Saxon, and the affix *ment* is Latin (mentum).

Falsehood. The stem *false* is Latin, and the affix *hood* is Saxon.

Useful. The stem *use* is Latin, and the affix *ful* is Saxon.

Martyrdom. The stem *martyr* is Greek, and the affix *dom* is Saxon.

Tranship. The prefix *trans* is Latin, and the stem *ship* is Saxon.

Lord-Lieutenant. *Lord* is Saxon, and *lieutenant* is French (derived from Latin).

Grandfather. *Grand* is Latin (grandis), and *father* is Saxon.

Undervalue. The prefix *under* is Saxon, and the stem *value* is Latin.

Publicly. The stem *public* is Latin, and the affix *ly* is Saxon.

Many hybrids have become naturalized in English and are employed both by the people in ordinary conversation and by good authors in elegant compositions. As appears from the preceding examples, they consist chiefly of—

(1) A Saxon stem with a Latin prefix or affix.

(2) A Latin stem with a Saxon prefix or affix.

Some words are derived from names of persons or places. The following are examples.

(1) **From names of persons.**

simony from Simon Magus.	brougham from Lrd. Brougham.
tantalize „ Tantalus.	macadamize „ Mc Adam.
gordian „ Gordius.	quixotic „ Don Quixote.
volcano „ Vulcan.	mausoleum „ Mausolus.

(2) **From names of places.**

cambric from Cambray.	worsted from Worsted.
damask „ Damascus.	magnet „ Magnesia.
port „ Oporto.	guinea „ Guinea.
currant „ Corinth.	sherry „ Xeres.

III. PREFIXES.

(1) SAXON PREFIXES.

A; *in, on.* Ashore, aground, abed, asleep.
Be; with an *intensive force*, or *making an intransitive verb transitive.* Bewail, besprinkle, befriend, bespeak.
For; having a *negative force.* Forbid, forget, forswear.
Fore; *before.* Foretell, forewarn, forearm.
Mid; *middle.* Midway, midnight, midshipman.
Mis; denoting *error* or *failure.* Mistake, mishap, misconduct.
Out; *beyond.* Outbid, outrun, outlive.
Over; *above, beyond.* Overflow, overtake, overcome.
To; *this.* To-day, to-morrow, to-night.
Un; *not.* Unbearable, unfurl, undo.
Under; *beneath, below.* Undersell, undertake.
Up; *upwards, up.* Upset, upheave.
With; *against, from.* Withstand, withdraw, withhold.

(2) LATIN PREFIXES.

See "Pupil Teacher's Course. Second Year."

(3) GREEK PREFIXES.

A, or **an** (α, αν); *without, not.* Apathy, anarchy.
Amphi (αμφι); *about, around, both.* Amphitheatre, amphibious.
Ana (ανα); *up, through.* Analogy, analyse.
Anti (αντι); *against.* Antichrist, antagonist, antarctic.
Apo (απο); *from, away.* Apostle, apology, aphelion.
Arch (αρχη); *first, chief.* Archangel.
Auto (αυτος); *self.* Autograph, autocrat, autobiography.
Cata (κατα); *down.* Cataract, catastrophe.
Dia (δια); *through.* Diameter, diagonal.
En, or **em** (εν); *in.* Endemic, emphasis.
Epi (επι); *upon.* Epitaph, epilogue.
Eu (ευ); *well.* Eulogy, euphony.
Ex, **ec** (εξ); *from, out of.* Ecstasy, exodus.
Hēmi (ήμι); *half.* Hemisphere.

Hyper (ὑπερ) ; *over.* Hypercritical, hyperbole.
Hypo (ὑπο) ; *under.* Hypothesis.
Meta (μετα) ; *change.* Metaphor, metamorphosis.
Para (παρα) ; *beside, against.* Paraphrase, paradox.
Peri (περι) ; *around.* Perimeter, period.
Syn, syl, sym (συν) ; *with, together.* Syntax, syllable, sympathy.

IV. AFFIXES.

Lists of affixes (with examples), arranged according to their meanings and the parts of speech they help to form, have already been given in our books for Candidates and Pupil Teachers of First Year. We now give them classified according to the languages from which they are derived.

(1) Saxon Affixes.

(*a*) **To Nouns.** Ar, ard (*or* art), ster, ess, kin, let, ling, ock, age, dom, ery, hood (*or* head), lock, ness, ship.

(*b*) **To Adjectives.** Ful, some, y, like, by, en, ern, fold, ward, less, ish.

(*c*) **To Verbs.** En, er, ish.

(*d*) **To Adverbs.** Ly, ward (*or* wards), ways, wise, long.

(2) Latin and French Affixes.

(*a*) **To Nouns.** Ant, ance *or* ence (Lat. antia or entia), ary (Lat. arius), ate (Lat. atus), ee (Fr. é), eer (Fr. aire, eur), ent (Lat. ens), ite (Lat. itus), ive (Lat. ivus), or (Lat. or), ine (Lat. ina), trix (Lat. trix), cule *or* cle (Lat. culus), ule (Lat. ulus), cy (Lat. tia), ice (Let. itia), ment (Lat. mentum), our (Lat. or), tion, sion, *or* ion (Lat. io), tude (Lat. tudo), ture *or* ure (Lat. ura), ty (Lat. tas).

(*b*) **To Adjectives.** Ose *or* ous (Lat. osus), ate (Lat. atus), al (Lat. alis), an (Lat. anus), ar (Lat. aris), ary (Lat. arius), eel, (Lat. ilis), id (Lat. idus), il *or* ile (Lat. ilis), ine (Lat. inus), tive (Lat. tivus), tory *or* sory (Lat. torius *or* sorius) able, ible, *or* uble (Lat. bilis), ple *or* ble (Lat. plex), ant *or* ent (Lat. ans *or* ens).

(*c*) **To Verbs.** Fy (Lat. fio).

(3) GREEK AFFIXES.

(*a*) **To Nouns.** Ist (Gr. ιστης), isk (Gr. ισκος), ic *or* ics (Gr. ικος), ism (Gr. ισμα), ma (Gr. μα), sis (Gr. σις).

(*b*) **To Adjectives.** Ac (Gr. ακος), ic, ical (Gr. ικος).

(*c*) **To Verbs.** Ise *or* ize (Gr. ιζω).

V. SAXON, LATIN, AND GREEK DERIVATIONS.

The following is a list of Saxon (S.), Latin (L.), and Greek (Gr.) words, with examples of English words derived from them. The list is a somewhat full one, and the pupil should at first learn only those which are printed in thicker type, as being the most important.

Ac (S.), *an oak;* acorn (=ac-corn).

Acer, acris (Lat.), *sharp;* acrid, acrimony, eager (through French aigre).

Acerbus (L.), *bitter;* acerbity, exacerbate.

Acidus (L.), *sour;* acid.

Acuo (L.), *I sharpen;* acute.

Adulor (L.), *I flatter;* adulation.

Ædes (L.), *a house;* edify, edifice.

Æfre (S.), *ever;* ever, every.

Æfter (S.), *after;* after, afterwards.

Æmulus (L.), *vying with;* emulate.

Æquus (L.), *equal, level;* equal, adequate, equator, equinox, equity, iniquity.

Aēr (αηρ, Gr.), *air;* aërial, air, aëronaut.

Æstimo (L.), *I value;* esteem, estimate, inestimable.

Æstus (L.), *the tide;* estuary.

Æternus (L.), *eternal;* eternal, coeternal, eternity.

Ævum (L.), *an age;* coeval, primeval, mediæval.

Ager (L.), *a field;* agriculture, agrarian.

Agger (L.), *a heap;* exaggerate.

Ago (αγω, Gr.), *I lead, drive;* demagogue, synagogue.

Ago, actum (L.), *I do*; agent, act, action, active, counteract, transact.
Agōn (αγων, Gr.), *a contest*; agony, antagonist.
Akouo (ακουω, Gr.), *I hear*; acoustic.
Ala (L.), *a wing*; aisle.
Alacer (L.), *cheerful*; alacrity.
Albus (L.), *white*; albumen, Albion.
Alius (L.), *another*; alienus (L.), *of another*; alien, alibi.
Alo (L.), *I nourish*; aliment, alimony.
Alter (L.), *another*; alter, altercation, alternate, adulterate.
Altus (L.), *high*; altitude, exalt, altar.
Ambulo (L.), *I walk*; perambulate, amble, somnambulist, preamble.
Amo (L.), *I love*; **amicus** (L.), *a friend*; amatory, amiable, enamour, amicable; **inimicus** (L.) *an enemy*; inimical.
Amplus (L.), *large*; ample, amplify.
Angelos (αγγελος, Gr.), *a messenger*; angel, archangel.
Ango, anxi (L.), *I choke, vex*; anger, anxiety, anguish.
Angulus (L.), *a corner*; angle, rectangle, triangle.
Anima (L.), *breath, life, the soul*; **animus** (L.), *the mind*; animal, animate, unanimous, animadvert, magnanimity.
Annulus (L.), *a ring*; annular.
Annus (L.), *a year*; annual, annals, biennial, anniversary.
Anthos (ανθος, Gr.), *a flower*; anthology, polyanthus.
Anthrōpos (ανθρωπος, Gr.), *a man*; philanthropy, misanthrope, anthropophagi.
Antiquus (L.), *ancient*; antiquity, antiquary.
Anus (L.), *an old woman*; anile.
Aperio (L.), *I open*; aperient, aperture, April.
Apis (L.), *a bee*; apiary.
Apto (L.), *I fit*; aptus (L.), *fitted*; apt, adapt, aptitude, inept.
Aqua (L.), *water*; aquatic, aqueduct, subaqueous, terraqueous.
Aquila (L.), *an eagle*; aquiline.
Arbiter (L.), *an umpire*; arbitrate.
Arbor (L.), *a tree*; arbour.
Arca (L.), *a chest*·

Archē (αρχη, Gr.), *beginning, rule;* anarchy, archangel, archbishop, archduke, tetrarch, heptarchy, monarch, patriarch.
Arcus (L.), *a bow;* arch, archer.
Ardeo, arsum (L.), *I burn;* ardent, arson.
Arduus (L.), *steep;* arduous.
Argentum (L.), *silver;* argent.
Arguo (L.), *I show, prove;* argue, argument.
Aridus (L.), *dry;* arid.
Aristos (αριστος, Gr.), *best;* aristocracy.
Arithmos (αριθμος, Gr.), *number;* arithmetic, logarithm.
Arktos (αρκτος, Gr.), *a bear;* arctic, antarctic.
Arma (L.), *arms;* arm, arms, armour, unarm.
Aro (L.), *I plough;* arable.
Ars, artis (L.), *art;* art, artful, artist, artificial.
Artus (L.), *a joint;* article, articulate.
Asinus (L.), *an ass;* asinine.
Asper (L.), *rough;* exasperate.
Astron (αστρον, Gr.), *a star;* astronomy, astrology, asterisk, disaster.
Atmos (ατμος, Gr.), *vapour;* atmosphere.
Atrox (L.), *fierce, cruel;* atrocious, atrocity.
Audax (L.), *bold;* audacious, audacity.
Audio, auditum (L.), *I hear;* audible, audience.
Augeo, auctum (L.), *I increase;* augment, auction, author, authority.
Aurum (L.), *gold;* auriferous.
Autos (αυτος, Gr.), *self;* autograph, autobiography, autocracy.
Auxilium (L.), *help;* auxiliary.
Avarus (L.), *covetous;* avaricious, avarice.
Avidus (L.), *greedy;* avidity.
Avis (L.), *a bird;* aviary.

Ballo (βαλλω, Gr.), *I throw;* hyperbole, parable, symbol, parabola.
Bapto (βαπτω, Gr.), *I dip;* baptize, etc.
Barba (L.), *a beard;* barb, barber.

Baros (βαρος, Gr.), *weight;* barometer, barytone.
Basis (βασις, Gr.), *the bottom, foundation;* basis, base.
Beatan (S.), *to beat;* beat, abate.
Beatus (L.), *blessed;* beatitude.
Becuman (S.), *to fall out* or *happen;* become.
Bellum (L.), *war;* belligerent, rebel.
Bene (L.), *well;* benefit, beneficent, benediction, benevolent, benefice, benefactor.
Benignus (L.), *kind;* benign, benignant.
Beorgan (S.), *to protect;* burrow.
Beran (S.), *to bear;* bear, forbear, burden.
Biblos (βιβλος, Gr.), *a book;* bible, bibliophile.
Bibo (L.), *I drink;* imbibe, winebibber.
Biddan (S.), *to ask, command;* bid, forbid.
Bindan (S.), *to bind;* bind.
Bini (L.), *two by two;* binary, binocular, combine.
Bios (βιος, Gr.), *life;* biography, amphibious.
Bis (L.), *twice;* biennial, biscuit, bisect, bissextile.
Bodian (S.), *to announce, preach;* forebode.
Bonus (L.), *good;* bounty, bonus, boon.
Bos, bovis (L.), *an ox;* bovine.
Bosko (βοσκω, Gr.), *I feed;* proboscis.
Bot (S.), *reparation, satisfaction;* boot.
Brecan (S.), *to break;* break, bray, breach, brake.
Brevis (L.), *short;* brevity, brief, abbreviate.
Bugan (S.), *to bend;* bow, bay, bugle.
Burg (S.), *city, fortress;* borough, burg, burgess.
Byldan (S.), *to confirm;* build.
Byrnan (S.), *to burn;* burn.

Cado, casum (L.), *I fall;* cadence, case, cascade, decay, accident, chance, occasion, coincide, casual.
Cædo, cæsum (L.), *I cut, kill;* circumcise, homicide, suicide,
Calculus (L.), *a pebble;* calculate. [incision.
Calor (L.), *heat;* caloric.
Calx, calcis (L.), *limestone;* chalk, calcareous, calcine.

Campus (L.), *a plain;* camp, encamp.
Candeo (L.), *I am white, shine;* candent, candle, candid.
Canis (L.), *a dog;* canine, kennel.
Cano, cantum (L.), *I sing;* incantation, chant, canorous, cant, accent, enchant, precentor.
Caper (L.), *a goat;* caper, Capricorn.
Capillus (L.), *a hair;* capillary.
Capio, cepi, captum (L.), *I take;* captive, accept, anticipate, receive, capable.
Caput, capitis (L.), *a head;* capital, cape, captain, chapter.
Carbo (L.), *a coal;* carbon.
Carcer (L.), *a prison;* incarcerate.
Cardo, cardinis (L.), *a hinge;* cardinal.
Caro, carnis (L.), *flesh;* carnal, carrion, incarnate, charnel.
Carus (L.), *dear;* charity, caress.
Castigo (L.), *I chastise;* castigate, chastise.
Castus (L.), *chaste;* chastity, incest, chaste.
Causa (L.), *a cause;* cause, accuse, excuse,
Caveo, cautum (L.), *I beware;* caution, precaution.
Cavus (L.), *hollow;* cave, concave, cavity, excavate.
Ceap (S.), *cattle; purchase, business;* cheap, chapman.
Cedo, cessum (L.), *I go, yield;* cede, cease, intercede, recede, proceed, concede, decease, inaccessible, succeed.
Celer (L.), *swift;* celerity, accelerate.
Celo (L.), *I hide;* conceal.
Censeo (L.), *I think, judge;* censure, censor.
Centum (L.), *a hundred;* century, centurion, **cent.**
Ceorl (S.), *a man, husband;* churl.
Cera (L.), *wax;* cerement.
Cerno, cretum (L.), *I discern, distinguish;* discern, concern, discreet, secret, decree.
Certus (L.), *sure;* certain, certify, ascertain.
Charta (L.), *paper;* chart, card, cartoon, charter.
Cheir (χειρ, Gr.), *hand;* chirography, chiromancy.
Cholē (χολη, Gr.), *bile;* melancholy, choler.
Chordē (χορδη, Gr.), *a string;* chord, trichord,

Choros (χορος, Gr.), *a dance, chorus;* chorus, choir.
Chrio (χριω, Gr.), *I anoint;* Christ, Christian, chrism.
Chrōma (χρωμα, Gr.), *colour;* chromatic.
Chronos (χρονος, Gr.), *time;* chronic, chronicle, anachronism, chronology, chronometer.
Chrusos (χρυσος, Gr.), *gold;* chrysolite, chrysalis.
Cingo, cinctum (L.), *I gird;* cincture, succinct, precinct.
Circum (L.), *round;* circumference, circumnavigate, circuit.
Circus (L.), *a circle;* circle, semicircle, circus.
Cito (L.), *I call, rouse;* cite, citation, excite.
Civis (L.), *a citizen;* civil, civic.
Clamo (L.), *I cry out;* clamour, exclaim, proclaim.
Clarus (L.), *bright, clear;* clear, clarify, declare.
Claudo, clausum (L.); **cludere**, clusum (L.), *I shut;* exclude, conclude, clause, close, inclose.
Clemens (L.), *merciful, mild;* clemency, clement, inclement.
Clino (L.), *I bend;* incline, decline, declension.
Clivus (L.), *sloping;* declivity.
Cnawan (S.), *to know;* know, acknowledge.
Cniht (S.), *a boy, youth;* knight.
Cœlebs (L.), *unmarried;* celibacy.
Cœlum (L.), *heaven;* celestial.
Cogito (L.), *I think;* cogitate.
Cognosco (L.), *I know;* recognise, cognizant.
Collum (L.), *neck;* collar.
Colo, cultum (L.), *I till;* colony, cultivate, culture, agriculture.
Color (L.), *colour;* colour.
Columna (L.), *a column;* column, colonnade.
Comes (L.), *a companion;* concomitant, count.
Commodus (L.), *convenient;* commodious, incommode.
Communis (L.), *common;* common, communion, community.
Consilium (L.), *counsel;* counsel.
Copia (L.), *plenty;* copious.
Copulo (L.), *I join together;* copulative, couple.
Coquo, coctum (L.), *I boil, cook;* cook, decoction, biscuit.
Cor, cordis (L.), *the heart;* cordial, courage, discord, core.

Cornu (L.), *a horn;* unicorn, capricorn.
Corona (L.), *a crown;* crown, coronation, coronet.
Corpus, corporis (L.), *the body;* corporeal, incorporate, corporation, corpse, corpulent.
Cras (L.), *to-morrow;* procrastinate.
Credo, creditum (L.), *I believe;* creed, credit, creditable, incredible.
Creo (L.), *I create;* create, procreate, recreation.
Cresco, cretum (L.), *I grow;* increase, crescent, excrescence, accretion.
Crimen (L.), *a crime;* crime, criminal, incriminate.
Crux, crucis (L.), *a cross;* crusade, crucify, crucial, excruciating.
Cubo, cumbo (L.), *I lie down;* succumb, incumbent, concubine, recumbent, incubation.
Culina (L.), *a kitchen;* culinary.
Culmen (L.), *the top;* culminate.
Culpa (L.), *a fault;* culpable, inculpate, exculpate.
Cumulus (L.), *a heap;* accumulate.
Cunnan (S.), *to know;* can, ken, cunning.
Cupio (L.), *I desire;* cupidity, concupiscence.
Cura (L.), *care;* cure, secure, curious, accurate, procure, sinecure, curator.
Curro, cursum (L.), *I run;* current, course, succour, excursion, occur, discourse, corsair.
Curvus (L.), *bent, crooked;* curve, curvilinear.
Custos, custodis (L.), *a guard;* custody.
Cutis (L.), *skin;* cuticle.
Cwellan (S.), *to kill;* kill, quail, quell.
Cwen (S.), *a woman, queen;* queen, quean.

Damnum (L.), *a loss;* **damno** (L.), *I condemn;* damage, condemn, indemnify.
Debeo, debitum (L.), *I owe;* debt, due, debit, debenture.
Decan (S.), *to cover;* deck, bedeck.
Decem (L.), *ten;* December, decimal, duodecimal, decimate, decennial.

Deceo (L.), *I become, suit;* decent, decorous.
Defendo (L.), *I defend;* defend, fence.
Deka (δεκα, Gr.), *ten;* decade, decagon, decalogue.
Deleo (L.), *I blot out;* indelible, delete.
Delfan (S.), *to dig;* delve.
Dēmos (δημος, Gr.), *the people;* demagogue, democracy, epidemic.
Dendron (δενδρον, Gr.), *a tree;* rhododendron.
Dens, dentis (L.), *a tooth;* dentist, indented, trident.
Densus (L.), *thick, close;* dense, condense.
Despotēs (δεσποτης, Gr.), *a master;* despot.
Deterior (L.), *worse;* deteriorate.
Deus (L.), *God;* deity, deify.
Deuteros (δευτερος, Gr.), *second;* Deuteronomy.
Dexter (L.), *right* (hand); dexterity, ambidexter.
Dico, dictum (L.), *I say, tell;* dictate, benediction, predicate, contradict, verdict, edict, predict.
Dies (L.), *a day;* dial, diary, diurnal.
Digitus (L.), *a finger;* digit, digital.
Dignus (L.), *worthy;* dignity, deign, disdain, condign.
Dis (δις, Gr.), *twice;* dilemma, diphthong, distich.
Disco (L.), *I learn;* disciple, discipline.
Divido, divisum (L.), *I divide;* divide, division.
Divinus (L.), *divine;* divine, divination.
Do, datum (L.), *I give;* dative, add, addition, condition.
Doceo, doctum (L.), *I teach;* docile, doctor, doctrine.
Doleo (L.), *I grieve;* condole, dolorous.
Dominus (L.), *a master;* dominate, domain, dominion.
Domo (L.), *I tame, subdue;* indomitable.
Domus (L.), *a house;* dome, domestic, domicile.
Dono, donatum (L.), *I give;* donation, donor, pardon.
Dormio (L.), *I sleep;* dormant, dormitory, dormouse.
Doxa (δοξα, Gr.), *opinion, glory;* doxology, orthodox, heterodox, paradox.
Dragan (S.), *to drag;* drag, draw, draught, dray.
Dubius (L.), *doubtful;* dubious, doubt, indubitable.

Duco, ductum (L.), *I lead;* duke, conduct, introduce, produce, seduce, educate.
Dunamis (δυναμις, Gr.), *power;* dynamics.
Duo (L.), *two;* duplex (L.), *twofold;* duel, duet, double, duplex.
Durus (L.), *hard;* endure.

Eage (S.), *eye;* eye, daisy.
Eald (S.), *old;* old, eld, alderman, elder.
Ebrius (L.), *drunken;* ebriety, inebriate.
Ecclēsia (εκκλησια, Gr.), *an assembly, church;* ecclesiastical.
Edo (L.), *I eat;* edible.
Ego (L.), *I;* egotist.
Eidos (ειδος, Gr.), *form;* idol, typhoid, rhomboid.
Elektron (ελεκτρον, Gr.), *amber;* electricity.
Emineo (L.), *to project, stand forth, excel;* eminent.
Emo, emptum (L.), *I buy;* redeem, exempt.
Eo, itum (L.), *I go;* exit, transit, circuit.
Erēmos (ερημος, Gr.), *solitary;* hermit.
Ergon (εργον, Gr.), *a work;* energy, metallurgy.
Erro (L.), *I wander;* err, erratic, erroneous.
Esca (L.), *food;* esculent.
Esse (L.), *to be;* essence, essential, interest.
Ethnos (εθνος, Gr.), *a nation;* ethnology.
Ethos (εθος, Gr.), *a custom;* ethics.
Etumos (ετυμος, Gr.), *true, real;* etymology.
Eu (ευ, Gr.), *well;* eulogy, eucharist, euphemism.
Examino (L.), *I weigh, examine;* examine.
Exemplum (L.), *a model;* example, exemplary, sample.
Experior, expertum (L.), *I try;* experiment, experience, expert.

Faber (L.), *a workman;* fabric.
Fabula (L.), *a story, fable;* fable, fabulous.
Facies (L.), *a face, appearance;* face, surface, superficies.
Facilis (L.), *easy;* facility, difficult.
Facio, factum (L.), *I make, do;* fact, faction, perfect, infect, benefactor, factory, counterfeit, perfect, manufacture.

Fallo, falsum (L.), *I deceive;* false, fallacious, fail, fallible.
Fama, (L.), *report, fame;* fame, defamation, infamous.
Familia (L.), *a family;* family, familiar.
Fanum (L.), *a temple;* fane, profane.
Faran (S.), *to go;* fare, ferry, welfare.
Fari, fans (L.), *to speak;* infant, affable, nefarious.
Fastus (L.), *pride;* fastidious.
Fateor, fassus (L.), *I confess;* profess, confess.
Fatigo (L.), *I weary;* fatigue, indefatigable.
Fatuus (L.), *foolish;* infatuate.
Faveo (L.), *I favour;* favour, favourite.
Febris (L.), *fever;* febrile.
Felis (L.), *a cat;* feline.
Felix, felicis (L.), *happy;* felicity.
Femina (L.), *a woman;* effeminate, feminine.
Feower (S.), *four;* four, forty, firkin.
Fero, latus (L.), *I bear;* transfer, circumference, differ, suffer, fertile, translate, relate, legislate.
Ferox (L.), *fierce;* ferocious.
Ferrum (L.), *iron;* ferreous, farrier.
Ferveo (L.), *I boil;* fervent, effervesce.
Festus (L.), *joyful;* feast, festive.
Fibra (L.), *a fibre;* fibre.
Fido (L.), *I trust;* fides (L.), *faith;* confide, faith, fidelity, fealty, fief, infidel.
Figo, fixum (L.), *I fix;* fix, affix, prefix.
Filius (L.), *a son;* filial, affiliate.
Findo, fissum (L.), *I cleave;* fissure.
Fingo, fictum (L.), *I form, fashion;* feign, fiction, fictile, effigy, figure.
Finis (L.), *the end;* **finio** (L.), *I finish;* confine, define, final, finite, infinite.
Firmus (L.), *strong, firm;* firm, affirm, confirm, infirm.
Flagitium (L.), *wickedness;* flagitious.
Flagro (L.), *I burn;* flagrant.
Flamma (L.), *a flame;* inflammation.

Flecto, flexum (L.), *I bend;* flexible, circumflex, genuflection, inflection.

Fleogan (S.), *to fly;* fly, fledge.

Fligo, flictum (L.), *to dash;* afflict, conflict, profligate.

Flo, flatum (L.), *I blow;* inflate, flatulent, flute.

Flos, floris (L.), *a flower;* floral, florid, flourish, flour.

Fluo, fluxum (L.), *I flow;* fluent, fluid, fluxion, influence, affluence, confluent, superfluous.

Fodio, fossum (L.), *I dig;* fosse, fossil.

Fœdus, fœderis (L.), *a treaty;* federal, confederate.

Folium (L.), *a leaf;* foliage, trefoil, foil, folio.

Fons (L.), *a fountain;* fountain, font, fount.

Forma (L.), *a form;* form, deform, uniform, nonconformist.

Formido (L.), *I fear;* formidable.

Foro (L.), *I bore;* perforate.

Fors, fortis (L.), *chance;* **fortuna** (L.), *fortune;* fortune, unfortunate, fortuitous.

Fortis (L.), *strong, brave;* fort, fortitude, fortify, force, comfort.

Frango, fractum (L.), *I break;* fraction, fracture, fragile, infringe, refract, frail, fragment.

Frater (L.), *a brother;* fraternal, friar, confraternity, fratricide.

Fraus, fraudis (L.), *fraud;* fraud, defraud, fraudulent.

Frequens (L.), *frequent;* frequent.

Frico, frictum (L.), *I rub;* friction.

Frigeo (L.), *I am cold;* **frigidus** (L.), *cold;* frigid, refrigerate.

Frons, frontis (L.), *the forehead;* front, frontal, affront, effrontery, frontispiece.

Fructus (L.), *fruit;* fruit, fruition, fructify.

Frustra (L.), *in vain;* frustrate.

Fugio (L.), *I flee;* fugitive, subterfuge, refuge.

Fulgeo (L.), *I shine;* refulgent.

Fulmen (L.), *a thunderbolt;* fulminate.

Fumus (L.), *smoke;* fume, perfume, fumigate.

Fundo, fusum (L.), *I pour;* found, fuse, refund, confound, confusion.

Fundus (L.), *the bottom;* profound, foundation, fundamental.
Fungor, functus (L.), *I discharge* (a duty); function, perfunctory, defunct.
Fur (L.), *a thief;* furtive.

Gala (γαλα, Gr.), *milk;* galaxy.
Gallus (L.), *a cock;* gallinaceous.
Gameo (γαμεω, Gr.), *I marry;* bigamist, polygamy.
Garrio (L.), *I prattle;* garrulous.
Gast (S.), *spirit, life;* ghost, aghast, ghastly, gas.
Gastēr (γαστηρ, Gr.), *the belly;* gastric.
Gē (γη, Gr.), *the earth;* geography, geology, geometry, perigee, apogee, geocentric.
Gelifan (S.), *to believe;* believe.
Gelu (L.), *frost, ice;* congeal, gelatine, jelly.
Gennao (γενναω, Gr.), *I produce;* oxygen, hydrogen.
Genos (γενος, Gr.), *a race, kind;* genealogy.
Gens, gentis (L.), *a nation;* Gentile, genteel.
Genu (L.), *the knee;* genuflection.
Genus, generis (L.), *a kind;* genus, gender, generation.
Gerefa (S.), *a steward, governor;* sheriff, reeve.
Gero, gestum (L.), *I bear, carry;* gesture, suggest, belligerent, digest, vicegerent.
Gifan (S.), *to give;* give, forgive.
Gigas, gigantos (γιγας, Gr.), *a giant;* gigantic.
Gigno, genitum (L.), *I beget;* progeny.
Gignōsko (γιγνωσκω, Gr.), *I know;* gnostic, prognostic.
Glacies (L.), *ice;* glacier, glass.
Gladius (L.), *a sword;* gladiator.
Glans, glandis (L.), *an acorn;* gland.
Globus (L.), *a ball;* globe, globular.
Glomero (L.), *I roll into a ball;* conglomerate.
Glōtta (γλωττα, Gr.), *a tongue;* glossary, polyglot.
God (S.), *good;* God, good, gospel, gossip.
Gōnia (γωνια, Gr.), *a corner, an angle;* heptagon, polygon, trigonometry.

Gradior, gressum (L.), *I go;* **gradus** (L.), *a step;* grade, egress, progress, pedigree, transgress, graduate.

Gramma (γραμμα, Gr.), *a letter, that which is written;* grammar, diagram, anagram, epigram, programme, parallelogram.

Grandis (L.), *great;* grand, aggrandize, grandfather.

Granum (L.), *a grain of corn;* grain, granary, granite, pomegranate.

Grapho (γραφω, Gr.), *I write;* graphic, geography, autograph, biography, telegraph, paragraph, lithograph.

Gratia (L.), *favour;* grace, graceful.

Gratus (L.), *thankful, agreeable;* grateful.

Gravis (L.), *heavy;* grave, gravity, aggravate, grief.

Grex, gregis (L.), *a flock;* gregarious, aggregate.

Gripan (S.), *to seize;* gripe, grip, grapple.

Guberno (L.), *I steer, govern;* govern.

Gumnos (γυμνος, Gr.), *naked;* gymnastics.

Gusto (L.), *I taste;* disgust, gustatory.

Guttur (L.), *the throat;* guttural.

Habban (S.), *to have;* have, behave.

Habeo, habitum (L.), *I have;* habit, prohibit.

Habito (L.), *I dwell;* inhabit, habitation.

Hæreo, hæsum (L.), *I stick;* adhere, cohesion.

Hæres (L.), *an heir;* heir, hereditary, inherit.

Haireo (αἱρεω, Gr.), *I take;* diæresis, heresy.

Hal (S.), *whole, healthy;* hale, health.

Halig (S.), *holy;* holy, hallow, halidom.

Halo (L.), *I breathe;* exhale, inhale, exhalation.

Ham (S.), *home, dwelling;* home, hamlet, Cheltenham, etc.

Hand (S.), *hand;* hand, handsome.

Hangian (S.), *to hang;* hang, hinge.

Hap (S.), *luck, chance, fortune;* hap, happy, mishap, perhaps.

Haurio, haustum (L.), *I draw;* exhaust.

Healdan (S.), *to hold;* hold, behold, upholsterer.

Hedra (ἑδρα, Gr.), *a seat, sitting;* cathedral, sanhedrim.

Hekaton (ἑκατον, Gr.), *a hundred;* hecatomb.
Hēlios (ἥλιος, Gr.), *the sun;* aphelion, perihelion, heliotrope.
Hēmera (ἡμερα, Gr.), *a day;* ephemeral.
Hēmi (ἡμι, Gr.), *half;* hemisphere.
Hepta (ἑπτα, Gr.), *seven;* heptagon, heptarchy.
Heteros (ἑτερος, Gr.), *another;* heterodox, heteroclite.
Hex (ἑξ, Gr.), *six;* hexagon, hexameter.
Hiberno (L.), *I winter;* hibernate.
Hieros (ἱερος, Gr.), *holy;* hierarch, hierophant.
Hilaris (L.), *cheerful;* hilarity.
Hippos (ἱππος, Gr.), *a horse;* hippodrome, hippopotamus.
Histrio (L.), *an actor;* histrionic.
Hodos (ὁδος, Gr.), *a way;* period, synod, Exodus.
Holos (ὁλος, Gr.), *the whole;* catholic.
Homo (L.), *a man;* homicide, human.
Honestus (L.), *honourable;* honest.
Honor (L.), *honour;* honourable.
Hōra (ὡρα, Gr.), *hour;* hour, horoscope.
Horos (ὁρος, Gr.), *a boundary;* aorist, horizon.
Horreo (L.), *I shudder;* horror, abhor, horrid.
Hortor (L.), *I exhort;* exhort.
Hortus (L.), *a garden;* horticulture.
Hospes, hospitis (L.), *a guest, host;* hospitable, host, hospital.
Hostis (L.), *an enemy;* host, hostile.
Hudor, hudatos (ὑδωρ, Gr.), *water;* hydrogen, hydraulics, hydrostatics, hydrophobia.
Humeo (L.), *I am moist;* **humidus** (L.), *moist;* humour, humid.
Humilis (L.), *humble;* humble, humiliate.
Humnos (ὑμνος, Gr.), *a sacred song;* hymn.
Humus (L.), *the ground;* exhumation.
Hus (S.), *a house;* house, husband, hustings.

Idios (ἰδιος, Gr.), *one's own, peculiar;* idiom, idiosyncrasy, idiot.
Ignis (L.), *fire;* ignite, igneous.
Ignoro (L.), *I am ignorant;* ignorant, ignore.
Imago (L.), *image;* image, imagine.

Impero (L.), *I command;* **imperium** (L.), *a command;* imperative, empire, imperial, emperor, imperious.
Inanis (L.), *empty;* inane.
Ingenium (L.), *natural disposition, talent;* ingenious.
Ingenuus (L.), *inborn;* ingenuous.
Insula (L.), *island;* island, isle, insular, peninsula.
Integer (L.), *whole;* integer, disintegration, integrity.
Intelligo (L.), *I understand;* intelligent, intellect.
Ira (L.), *anger;* ire, irascible.
Isos (ισος, Gr.), *equal;* isothermal, isosceles.
Iter, itineris (L.), *a journey;* itinerant, itinerary.
Iterum (L.), *again;* reiterate.

Jaceo (L.), *I lie* (*down*); adjacent, circumjacent.
Jacio, jactum (L.), *I throw;* interjection, project, ejaculation, eject, reject, subject, adjective.
Jocus (L.), *a jest;* joke, jocular, jocose.
Judex, judicis (L.), *a judge;* judge, judicious, prejudice.
Jugulum (L.), *the throat;* jugular.
Jugum (L.), *a yoke;* conjugate, conjugal, subjugate.
Jungo, junctum (L.), *I join;* join, joint, disjoin, junction, conjunction.
Juro (L.), *I swear;* jury, conjure, abjure, perjure.
Jus, juris (L.), *right, law;* jurist, juridical, jurisprudence.
Justus (L.), *just;* just, justice.
Juvenis (L.), *young;* juvenile, junior.
Juvo, jutum (L.), *I help;* coadjutor.

Kalos (καλος, Gr.), *beautiful;* caligraphy.
Kalupto (καλυπτω, Gr.), *I hide;* apocalypse.
Kenos (κενος, Gr.), *empty;* cenotaph.
Kentron (κεντρον, Gr.), *a point;* **centrum** (L.), *a centre;* centre, centrifugal, eccentric, concentrate.
Keras (κερας, Gr.), *a horn;* rhinoceros.
Klimax (κλιμαξ, Gr.), *a ladder;* climax, anticlimax.
Komē (κομη, Gr.), *hair;* comet.

Koneo (κονεω, Gr.), *I serve;* deacon.
Kopto (κοπτω, Gr.), *I strike;* apocope, syncope.
Kosmos (κοσμος, Gr.), *order, the world;* cosmetic, microcosm.
Kratos (κρατος, Gr.), *power;* aristocracy, theocracy.
Kritēs (κριτης, Gr.), *a judge;* critic.
Krupto (κρυπτω, Gr.), *I hide;* crypt, apocrypha.
Kuklos (κυκλος, Gr.), *a circle;* cycle, encyclopædia.
Kuōn (κυων, Gr.), *a dog;* cynic.

Labium (L.), *a lip;* labial.
Labor (L.), *labour;* labour, laboratory.
Labor, lapsum (L.), *I slide, fall;* lapse, elapse, collapse.
Lac, lactis (L.), *milk;* lacteal.
Lacer (L.), *torn;* lacerate.
Lacryma (L.), *a tear;* lacrimose.
Lædo, læsum (L.), *I dash, hurt;* elide, collision.
Langueo (L.), *I fade, drop;* languid, languish.
Lapis, lapidis (L.), *a stone;* lapidary, dilapidate.
Lassus (L.), *weary;* lassitude.
Lateo (L.), *I lie hid;* latent.
Latus, lateris (L.), *a side;* lateral, equilateral.
Latus (L.), *broad;* latitude.
Laus, laudis (L.), *praise;* laud, laudatory.
Lavo (L.), *I wash;* lavatory, laundress.
Laxus (L.), *loose;* lax, relax.
Lecgan (S.), *to lay;* lay, ledge, ledger.
Lego, legatum (L.), *I send, despatch;* legate, legacy, allege.
Lego, lectum (L.), *I gather, read;* collect, legible, lesson, lecture, elect, college, legion.
Leipo (λειπω, Gr.), *I leave;* eclipse, ellipsis.
Lenis (L.), *gentle;* lenient.
Lentus (L.), *slow;* relent.
Leo (L.), *lion;* lion, dandelion, leopard, leonine.
Levis (L.), *light;* levity, lever, leaven.
Lex, legis (L.), *a law;* legal, loyal, legitimate, legislate.
Liber (L.), *free;* liberal, deliver.

Liber (L.), *a book;* library, libel.
Libo, libatum (L.), *I pour out;* libation.
Libra (L.), *a balance;* libro (L.), *I weigh;* deliberate, libration.
Licet (L.), *it is lawful;* a licence, to license, illicit.
Lignum (L.), *wood;* ligneous.
Ligo, ligatum (L.), *I bind;* ligament, league, religion, allegiance, oblige.
Limen (L.), *a threshold;* eliminate, preliminary.
Limes, limitis (L.), *a boundary;* limit, unlimited.
Linea (L.), *a line;* line, lineal, delineate.
Lingua (L.), *a tongue;* linguist, language.
Linquo, relictum (L.), *I leave;* delinquent, relinquish, relic, relict.
Liqueo (L.), *I melt;* liquid, liquor, liquefy.
Lis, litis (L.), *strife;* litigate.
Litera (L.), *a letter;* letter, literal, obliterate, alliteration.
Lithos (L.), *a stone* (λιθος, Gr.), *a stone;* lithograph, chrysolite.
Locus (L.), *a place;* local, locate, locomotion.
Logos (λογος, Gr.), *a word, discourse;* logic, dialogue, catalogue, astrology, apology, epilogue, syllogism.
Longus (L.), *long;* long, oblong, elongate, prolong.
Loquor, locutus (L.), *I speak;* loquacious, locution, eloquence, soliloquy, elocution.
Lucrum (L.), *gain;* lucre, lucrative.
Luctor (L.), *I struggle;* reluctant.
Ludo, lusum (L.), *I play;* ludicrous, delude, illusory.
Lugeo (L.), *I mourn;* lugubrious.
Lumen (L.), *light;* luminary, illuminate.
Luna (L.), *the moon;* lunar, interlunar, lunatic.
Luo, lutum (L.), *I wash;* ablution, dilute.
Luo (λυω, Gr.), *I loose;* analyse, paralyse.
Lustro (L.), *I purify, enlighten;* lustre, illustrate, lustration.
Lux, lucis (L.), *light;* **luceo** (L.), *I shine;* lucent, lucid, translucent, elucidate.

Macer (L.), *lean;* macerate.
Macula (L.), *a spot, stain;* immaculate, mackerel.

Magister (L.), *a master;* master, magistrate.
Magnus (L.), *great;* magnitude, magnify.
Major (L.), *greater;* major, majesty, majority, mayor.
Malleus (L.), *a hammer;* malleable.
Malus (L.), *bad;* malice, malady, maladministration.
Mando (L.), *I bid;* mandate, command, remand.
Maneo, mansum (L.), *I stay, remain;* permanent, remnant, manse.
Manteia (μαντεια Gr.), *divination;* necromancy.
Manus (L.), *the hand;* manuscript, manufacture, manumit, manage, manual, manacle, manœuvre, manipulate.
Mare (L.), *the sea;* marine, maritime, mariner, mermaid.
Mars, Martis (L.), *the god of war;* martial.
Martur (μαρτυρ, Gr.), *a witness;* martyr.
Mater (L.), *a mother;* maternal, matron, matricide, matriculate.
Mathēma (μαθημα, Gr.), *learning;* mathematics.
Maturus (L.), *ripe;* mature, premature.
Mēchanē (μηχανη, Gr.), *a means, contrivance;* machine, mechanic.
Medeor (L.), *I heal;* medicine, medical, remedy.
Medius (L.), *middle;* mediate, mean, mediant, medium, mediocrity, immediately, Mediterranean.
Mel (L.), *honey;* mellifluous.
Melas (μελας, Gr.), *black;* melancholy.
Melior (L.), *better;* ameliorate.
Melos (μελος, Gr.), *a song;* melody.
Memor (L.), *mindful;* **memini** (L.), *I remember;* memory, commemorate, remember, memorial, memorable.
Mendico (L.), *I beg;* mendicant.
Mendum (L.), *a fault;* mend, amend.
Mens, mentis (L.), *mind;* mental, vehement, demented.
Mereo, meritum (L.), *I deserve;* merit.
Mergo, mersum (L.), *I plunge;* immerge, emerge, immerse.
Meridies (L.), *midday;* meridian, postmeridian.
Merx, mercis (L.), *merchandise;* merchant, commerce, market, mercer, merchandise, mercantile.
Metallon (μεταλλον, Gr.), *metal;* metal, medal, mettle.

Mētēr (μητηρ, Gr.), *mother;* metropolis.
Metior, mensum (L.), *I measure;* measure, immense.
Metron (μετρον, Gr.), *a measure;* metronome, diameter, meter, barometer, thermometer, symmetry, chronometer.
Migro (L.), *I remove;* migrate, emigrant.
Mikros (μικρος, Gr.), *small;* microscope.
Miles, militis (L.), *a soldier;* military, militia, militant.
Mille (L.), *a thousand;* millenary, mile, millennium.
Minister (L.), *a servant;* minister.
Minor (L.), *less;* **minus** (L.), *I make less;* minor, mínute, diminish, minúte.
Miror (L.), *I wonder, admire;* miracle, admire.
Misceo, mixtum (L.), *I mix;* mix, promiscuous, miscellany.
Miser (L.), *wretched;* miser, miserable, commiserate.
Misos (μισος, Gr.), *hatred;* misanthropy.
Mitis (L.), *mild;* mitigate.
Mitto, missum (L.), *I send;* admit, emit, transmit, mission, missionary, promise.
Modus (L.), *a measure, manner;* mode, moderate, modify mood, modest, model, modulate.
Mola (L.), *a millstone;* meal, molar, emolument.
Mollis (L.), *soft;* mollify, emollient.
Moneo, monitum (L.), *I advise;* admonish, monitor.
Monos (μονος, Gr.), *single, alone;* monarch, monosyllable, monody, monopolize.
Mons, montis (L.), *a mountain;* mountain, surmount, promontory, ultramontane.
Monstro (L.), *I show;* demonstrate.
Morbus (L.), *a disease;* morbid.
Mordeo, morsum (L.), *I bite;* morsel, remorse.
Mors, mortis (L.), *death;* mortal, mortuary, immortal, mortify, mortgage.
Mos, moris (L.), *a custom;* moral.
Moveo, motum (L.), *I move;* move, remove, remote, motive
Multus (L.), *many;* multitude, multiple, multiply.
Mundus (L.), *the world;* mundane.

Munio, munitum (L.), *I fortify;* ammunition.
Munus (L.), *a gift;* remunerate, munificent.
Murus (L.), *a wall;* mural, immure.
Musa (L.), *a muse;* music, amuse, mosaic.
Muto (L.), *I change;* mutable, transmute, permutation.

Narro (L.), *I relate;* narrate, narrative.
Nascor, natus (L.), *I am born;* nascent, nature, native, cognate, nation.
Nasus (L.), *nose;* nasal, the Naze.
Naus (*ναυς*, Gr.), *a ship;* nautical, aeronaut.
Navis (L.), *a ship;* navy, navigate.
Neah (S.), *near;* near, nigh, neighbour.
Necto, nexum (L.), *I tie;* connect, annex.
Nego, negatum (L.), *I deny;* negative, abnegation.
Neos (*νεος*, Gr.), *new;* neology, neophyte.
Nervus (L.), *a sinew;* nerve, enervate.
Neuter (L.), *neither;* neutral.
Niger (L.), *black;* negro, denigrate.
Nihil (L.), *nothing;* annihilate.
Noceo (L.), *I hurt;* innocent, noxious, innocuous, noisome.
Nomen (L.), *a name;* noun, nominal, denominate.
Nomos (*νομος*, Gr.), *a law;* astronomy, Deuteronomy.
Norma (L.), *a law;* normal, enormous.
Nosco, notum (L.), *I know;* notion, notorious, incognito.
Nota (L.), *a mark;* note, annotate.
Novem (L.), *nine;* November.
Novus (L.), *new;* novel, innovate.
Nox, noctis (L.), *night;* nocturnal, equinox.
Nubo, nuptum (L.), *I marry;* nuptial, connubial.
Nudus (L.), *naked;* nude, denude.
Nullus (L.), *none;* annul, nullify.
Numerus (L.), *a number;* number, numerator, enumerate.
Nuntio (L.), *I tell;* announce, nuncio, renounce.
Nutrio (L.), *I nourish;* nurse, nutrition.

Octo (L.), (οκτω, Gr.), *eight;* octagon, octave, October.
Oculus (L.), *the eye;* ocular, inoculate.
Odē (ωδη, Gr.), *a song;* ode, monody, prosody, comedy.
Odium (L.), *hatred;* odium, odious.
Offendo, offensum (L.), *I offend;* offend, offensive.
Omen (L.), *a sign, omen;* omen, ominous, abominable.
Omnis (L.), *all;* omnipotent, omnivorous, omnibus.
Onoma (ονομα, Gr.), *a name;* anonymous, synonym.
Onus, oneris (L.), *a load, burden;* onerous, exonerate.
Opacus (L.), *dark;* opaque.
Opes (L.), *riches;* opulent.
Opinor (L.), *I think;* opinion, opine.
Opto (L.), *I wish;* option, optative, adopt.
Optomai (οπτομαι, Gr.), *I see;* optics.
Opus, operis (L.), *a work;* operate.
Orbis (L.), *a circle;* orb, exorbitant, orbit.
Ordo, ordinis (L.), *order;* order, ordain, co-ordinate.
Organon (οργανον, Gr.), *an instrument;* organ.
Orior, ortus (L.), *I arise;* oriental, original, abortion.
Ornis, ornithos (ορνις, Gr.), *a bird;* ornithology.
Orno (L.), *I adorn;* ornament, adorn.
Oro (L.), *I speak, pray;* oration, inexorable, oracle, adore.
Orthos (ορθος, Gr.), *right;* orthodox, orthography.
Os, oris (L.), *the mouth;* oral, orifice.
Ovum (L.), *an egg;* oval, oviparous.
Oxus (οξυς, Gr.), *sharp;* oxygen.

Pais (παις, Gr.), *a child;* pedagogue, pædobaptist.
Pallium (L.), *a cloak;* pall, palliate.
Pallor (L.), *paleness;* pallid.
Pando, pansum (L.), *I open, spread;* expand, compass.
Pango, pactum (L.), *I fix, agree;* compact.
Panis (L.), *bread;* pantry, company.
Par (L.), *equal;* par, pair, peer.
Pareo (L.), *I appear;* appear, apparent, transparent.
Pario (L.), *I bring forth;* parent, viviparous.

Paro (L.), *I prepare;* prepare, compare, repair.
Pars, partis (L.), *a part;* part, parcel, partner, party, parse.
Pasco, pastum (L.), *I feed;* pastor, repast.
Pateo (L.), *I lie open;* patent.
Pater (L.), *a father;* paternal, parricide, patriarch, patron, patrician.
Pathos (παθος, Gr.), *feeling;* pathos, pathetic, sympathy, antipathy.
Patior, passus (L.), *I suffer;* patient, passion, compassion, passive.
Patria (L.), *one's country;* patriot, expatriate.
Pauper (L.), *poor;* poverty, pauper.
Pax, pacis (L.), *peace;* peace, pacify, appease.
Pectus, oris (L.), *breast;* pectoral, expectorate.
Peculium (L.), *private property;* peculiar, peculate.
Pecunia (L.), *money;* pecuniary.
Pelagos (πελαγος, Gr.), *the sea;* Archipelago.
Pello, pulsum (L.), *I drive;* expel, pulse, expulsion.
Pendeo (L.), *I hang;* pendent, pendant, depend, suspend.
Pendo, pensum (L.), *I weigh, pay;* pension, compensate, expend.
Pene (L.), *almost;* peninsula, penultimate.
Penna (L.), *a feather;* pen, bipennate.
Pente (πεντε, Gr.), *five;* pentagon, pentateuch.
Periculum (L.), *danger;* peril.
Pes, pedis (L.), *a foot;* pedestrian, impede, quadruped, biped, pedal, expedite, pedler.
Peto, petitum (L.), *I ask;* petition, compete, appetite.
Petros (πετρος, Gr.), *a stone;* petrify, saltpetre.
Phaino (φαινω, Gr.), *I show;* epiphany, phenomenon, sycophant.
Philos (φιλος, Gr.), *a friend;* philosopher, philanthropy.
Phobos (φοβος, Gr.), *fear;* hydrophobia.
Phonē (φωνη, Gr.), *a sound, voice;* symphony.
Phthongos (φθογγος, Gr.), *a sound;* diphthong.
Phusis (φυσις, Gr.), *nature;* physical, physiology.
Pingo, pictum (L.), *I paint;* depict, picture, paint.
Piscis (L.), *a fish;* piscatory.

Pius (L.), *dutiful, pious;* pious, expiate.
Placeo (L.), *I please;* placable, complacent, placid, please.
Placo (L.), *I appease;* placable.
Planao (πλαναω, Gr.), *I wander;* planet.
Plango (L.), *I lament;* complain, plaintive.
Planus (L.), *level;* plain, plane, explain.
Plaudo, plausum (L.), *I clap hands, applaud;* applaud, plaudit, applause, plausible.
Plebs (L.), *the common people;* plebeian.
Plecto, plexum (L.), *I twist, weave;* perplex, complex.
Plenus (L.), *full;* plenty, plenary, replenish, complete.
Plico, plicatum (L.), *I fold;* pliable, ply, implicate, accomplice, complicated, multiply, surplice, duplicate.
Ploro (L.), *I bewail;* deplore, implore.
Pluma (L.), *a feather;* plume.
Plumbum (L.), *lead;* plumber, plummet, plumbago.
Plus, pluris (L.), *more;* plural, overplus.
Pneuma (πνευμα, Gr.), *breath, wind;* pneumatics.
Pœna (L.), *a punishment;* punish, penal, repent, subpœna.
Poieo (ποιεω, Gr.), *I make, do;* poet, poem.
Pōleo (πωλεω, Gr.), *I sell;* monopoly, bibliopolist.
Polio, politum (L.), *I polish;* polish, polite.
Polis (πολις, Gr.), *a city;* metropolis, police.
Polus (πολυς, Gr.), *many;* polygamy, polyglot, polysyllable.
Pomum (L.), *an apple;* pomegranate.
Pondus, ponderis (L.), *weight;* ponderous, ponder, preponderate, pound.
Pono, positum (L.), *I place;* position, deponent, expose, post, posture, suppose, compound.
Pons, pontis (L.), *a bridge;* pontoon.
Populus (L.), *the people;* populace, population, people.
Porto (L.), *I carry;* port, porter, export, import, transport.
Possum (L.), *I am able;* possible, potent, puissant.
Postulo (L.), *I demand;* expostulate, postulate.
Poto, potatum (L.), *I drink;* potable, potation, potion.
Pous, podos (πους, Gr.), *a foot;* tripod, polypus, antipodes.

Præda (L.), *booty;* prey, predatory, depredation.
Prasso (πρασσω, Gr.), *I do;* practice, impracticable.
Pravus (L.), *crooked, wicked;* depravity.
Precor, precatum (L.), *I pray;* precarious, deprecate.
Prehendo, prehensum (L.), *I seize;* apprehend, prehensile.
Premo, pressum (L.), *I press;* print, press.
Presbuteros (πρεσβυτερος, Gr.), *elder;* presbyter, priest.
Pretium (L.), *a price;* price, prize, appreciate.
Primus (L.), *first;* prime, primary, primrose, prince, principal.
Probo, probatum (L.), *I prove;* prove, probe, probable, approve.
Proprius (L.), *one's own;* proper, property, proprietor, appropriate.
Prōtos (πρωτος, Gr.), *first;* protocol, prototype.
Proximus (L.), *nearest;* approximate, proximity, approach.
Publicus (L.), *public;* public, republic.
Pudeo (L.), *I am ashamed;* repudiate, impudent.
Puer (L.), *a boy;* puerile.
Pugno (L.), *I fight;* pugnacious, impugn.
Pulvis (L.), *dust;* pulverize.
Pungo, punctum (L.), *I prick;* puncture, compunction, punctuate.
Pupus (L.), *a boy;* pupil.
Pur (πυρ, Gr.), *fire;* pyre, empyrean, pyrotechnics.
Purgo (L.), *I purge;* purge, purgation, expurgate.
Purus (L.), *pure;* pure, purify.
Pusillus (L.), *cowardly;* pusillanimous.
Puto (L.), *I cut, think;* amputate, compute.
Putris (L.), *rotten;* putrid.

Quæro, quæsitum (L.), *I ask;* query, question, inquire, quest, inquisitive, inquest, require.
Qualis (L.), *of what kind;* quality, qualify.
Quantus (L.), *how great;* quantity.
Quatio, quassum (L.), *I shake;* quash, concussion.
Quatuor (L.), *four;* **quartus** (L.), *fourth;* quadrant, quart, quadrangle, quadruped.

Queror (L.), *I complain;* querulous.
Quies, quietis (L.), *rest;* quiet.
Quinque (L.), *five;* quinquennial, quintessence.

Radius (L.), *a ray;* radius, irradiate.
Radix, radicis (L.), *a root;* radix, radical, eradicate, radish.
Rado, rasum (L.), *I scrape;* raze, erase, razor.
Ramus (L.), *a branch;* ramify.
Rapio, raptum (L.), *I snatch;* rapacious, rapid, rapine, rapture.
Ratio, rationis (L.), *reason;* reason, rational, ratio.
Rectus (L.), *straight;* rectilineal, rectangle, rectify.
Rego, rectum (L.), *I rule;* regent, reign, regiment, region, regnant, direct, rector.
Remus (L.), *an oar;* trireme.
Repo, reptum (L.), *I creep;* reptile.
Res (L.), *a thing;* real, republic, rebus.
Rex, regis (L.), *a king;* regal, royal, realm, regicide.
Rhodon (ῥοδον, Gr.), *a rose;* rhododendron.
Rideo, risum (L.), *I laugh;* ridicule, deride, risible.
Rigeo (L.), *I am stiff;* rigid.
Rigo (L.), *I water;* irrigate.
Rivus (L.), *a stream;* arrive, rival.
Robur, roboris (L.), *oak, strength;* robust, corroborate.
Rodo, rosum (L.), *I gnaw;* rodent, corrode, corrosion.
Rogo, rogatum (L.), *I ask;* rogation, interrogate, derogate, prerogative.
Rosa (L.), *a rose;* primrose, rosemary.
Rota (L.), *a wheel;* rotation, rotatory.
Rotundus (L.), *round;* round, rotundity.
Rudis (L.), *rude, ignorant;* rude.
Rumpo, ruptum (L.), *I break;* rupture, corrupt, eruption, interrupt, bankrupt.
Rus, ruris (L.), *the country;* rustic, rural.

Sacer (L.), *sacred;* sacred, sacrament, sacrilege, sacerdotal, sacrifice, sacristan, consecrate.

Sal (L.), *salt;* salt, saline, salary.
Salio, saltum (L.), *I leap;* salient, saltatory, assault, desultory.
Salus, salutis (L.), *safety, health;* salute, salutary, salubrious.
Salvus (L.), *safe;* save, salvage, salvation, salve.
Sanctus (L.), *holy;* sanctify, saint.
Sanguis, sanguinis (L.), *blood;* sanguine, sanguinary, consanguinity.
Sanus (L.), *sound, healthy;* sane, insane, sanatory.
Sapio (L.), *I taste, am wise;* sapient, savour, insipid.
Sarx, sarkos (σαρξ, Gr.), *flesh;* sarcasm, sarcophagus.
Satelles (L.), *a body guard;* satellite.
Satis (L.), *enough;* satisfy, sate, satiety.
Scala (L.), *a ladder;* scale, escalade.
Scando, scansum (L.), *I climb;* scan, ascend, descend.
Sceotan (S.), *to shoot;* shoot, shout, shut, shot.
Scindo, scissum (L.), *I cut;* rescind, scissors.
Scio, scitum (L.), *I know;* science, conscience, omniscient.
Scribo, scriptum (L.), *I write;* scribe, scribble, describe, inscribe, scripture, manuscript, postscript.
Scrutor (L.), *I examine;* scrutinize, scrutiny.
Seco, sectum (L.), *I cut;* secant, sect, insect, segment.
Seculum (L.), *an age;* secular.
Sedeo, sessum (L.), *I sit;* sedentary, seat, session, supersede, see (of a bishop), assize.
Sedo (L.), *I settle;* sedate, sedative.
Semen, seminis (L.), *a seed;* seminal, seminary, disseminate.
Semi (L.), *half;* semicircle.
Senex (L.), *old;* senior, senility, senate.
Sentio, sensum (L.), *I perceive;* sentient, sense, assent.
Sepelio, sepultum (L.), *I bury;* sepulchre.
Septem (L.), *seven;* septennial, September.
Sequor, secutus (L.), *I follow;* sequence, sequel, consecutive, obsequious, consequence, persecute.
Serenus (L.), *serene;* serene.
Sero, sertum (L.), *I join;* insert, series, assert.
Serpo (L.), *I creep;* serpent.

Servio (L.), *I serve;* **servus** (L.), *a slave;* serve, servant, **Servo** (L.), *I keep;* preserve, reserve, observe. [service.
Sex (L.), *six;* sextant.
Sidus, sideris (L.), *a star;* sidereal.
Signum (L.), *a mark, sign;* sign, signify, assign.
Silva (L.), *a wood;* sylvan, savage.
Similis (L.), *like;* similar, resemble, simulate.
Simul (L.), *together;* simultaneous, assemble.
Sisto (L.), *I stop;* assist, exist, resist.
Skopeo (σκοπεω, Gr.), *I look;* telescope, episcopal.
Socius (L.), *a companion;* sociable, associate.
Sol (L.), *the sun;* solar, parasol, solstice.
Solidus (L.), *solid;* solid, consolidate.
Solor, solatus (L.), *I comfort;* solace, console, disconsolate.
Solum (L.), *the ground;* soil.
Solus (L.), *alone;* sole, solitary, soliloquy, solo.
Solvo, solutum (L.), *I loose;* dissolve, solution, soluble.
Somnus (L.), *sleep;* somniference, somnambulist.
Sono (L.), *I sound;* sound, sonorous, consonant, unison.
Sophos (σοφος, Gr.), *wise;* sophist, philosopher.
Sorbeo (L.), *I suck in;* absorb.
Spargo, sparsum (L.), *I scatter;* disperse, sparse.
Spatium (L.), *a space;* space, expatiate.
Specio, spectum (L.), *I see;* spectacle, aspect, specious, spectator, prospect, inspection, speculate.
Spell (S.), *history, message;* spell, gospel.
Spero (L.), *I hope;* despair.
Sphaira (σφαιρα, Gr.), *a ball;* sphere, hemisphere.
Spiro (L.), *I breathe;* spirit, respire, expire, spiracle.
Splendeo (L.), *I shine;* splendid, resplendent.
Spolio (L.), *I plunder;* spoil, spoliation.
Spondeo, sponsum (L.), *I promise;* sponsor, respond.
Stagnum (L.), *a pool;* stagnant.
Statuo (L.), *I set up, appoint;* statute, statue, institute.
Stella (L.), *a star;* stellar, constellation.
Stello (στελλω, Gr.), *I send;* apostle, epistle.

Stereos (στερεος, Gr.), *firm, solid;* stereotype.
Sterno, stratum (L.), *I throw down;* consternation, prostrate.
Stichos (στιχος, Gr.), *a line, verse;* distich.
Stillo (L.), *I drop;* distil, instil, still.
Stimulus (L.), *a goad;* stimulate.
Stinguo, stinctum (L.), *I put out;* extinct, distinguish.
Stirps (L.), *stem, root;* extirpate.
Sto, statum (L.), *I stand;* stable, state, circumstance, substance, constant, distant, solstice.
Stringo, strictum (L.), *I bind;* strict, strain, strait.
Struo, structum (L.), *I build;* structure, construct, destroy,
Stupeo (L.), *I am amazed;* stupid. [construe.
Suadeo, suasum (L.), *I advise;* persuade, suasive.
Summus (L.), *highest;* sum, summit, consummate.
Sumo, sumptum (L.), *I take;* assume, consume, consumption.
Surgo, surrectum (L.), *I rise;* surge, resurrection.

Tabula (L.), *a board;* table, tablet, entablature.
Taceo (L.), *I am silent;* reticent, tacit, taciturn.
Tango, tactum (L.), *I touch;* tangent, tangible, contact, contiguous.
Taphos (ταφος, Gr.), *a tomb;* epitaph, cenotaph.
Tardus (L.), *slow;* tardy, retard.
Tasso (ταασσω, Gr.), *I arrange;* syntax, tactics.
Techne (τεχνη, Gr.), *art;* technical, pyrotechnics.
Tego, tectum (L.), *I cover;* tegument, protect, detect.
Tēle (τηλε, Gr.), *distant;* telescope, telegraph.
Temno, temptum (L.), *I despise;* contemn, contempt.
Tempero (L.), *I moderate;* temper, temperate.
Templum (L.), *a temple;* temple.
Tempus, temporis (L.), *time;* temporal, extempore, contemporary, tense.
Tendo, tensum, tentum (L.), *I stretch;* tent, tendon, extend, tension, intense, attention.
Teneo, tentum (L.), *I hold;* tenable, tendril, tenet, tenant, detain, retain, tenor, tenement.

Tener (L.), *tender;* tender.
Tento (L.), *I try;* tempt, attempt.
Tenuis (L.), *thin;* extenuate.
Tepeo (L.), *I am warm;* tepid.
Terminus (L.), *a boundary;* terminus, term, exterminate.
Tero, tritum (L.), *I rub;* contrite, trite, attrition.
Terra (L.), *the earth;* inter, terrestrial, subterranean.
Terreo (L.), *I frighten;* terrible, terror, deter.
Testis (L.), *a witness;* testify, test, protest, testament.
Tetra- (τετρα-, Gr.), *four;* tetrarch.
Teuchos (τευχος, Gr.), *a volume;* pentateuch.
Texo, textum (L.), *I weave;* text, context.
Theos (θεος, Gr.), *God;* theism, atheism, theology.
Thermē (θερμη, Gr.), *heat;* thermal, thermometer.
Thesis (θεσις, Gr.), *a placing;* hypothesis, synthesis.
Timeo (L.), *I fear;* timid.
Tingo, tinctum (L.), *I dip, stain;* tinge, taint, tincture, stain.
Tomē (τομη, Gr.), *a cutting;* anatomy, atom, epitome.
Topos (τοπος, Gr.), *a place;* topic, topography, utopian.
Torpeo (L.), *I am benumbed;* torpid.
Torqueo, tortum (L.), *I twist;* torture, distort, retort.
Torreo, tostum (L.), *I parch, burn;* torrid, toast.
Totus (L.), *the whole;* total.
Toxicum (L.), *poison;* intoxicate.
Traho, tractum (L.), *I draw;* trace, trait, tract, retract, subtract, retreat.
Tres (L.), (τρεις, Gr.), *three;* triad, triangle, trinity, trefoil, treble, triple.
Tribuo, tributum (L.), *I give;* tribute, contribute.
Trudo, trusum (L.), *I thrust;* intrude, intrusion.
Tuber (L.), *a swelling;* tuberous, protuberate.
Tueor, tuitum (L.), *I behold, protect;* tuition, tutor.
Tumeo (L.), *I swell;* tumid.
Tupos (τυπος, Gr.), *a mark, figure;* type, stereotype.
Turba (L.), *a crowd;* turbid, disturb.
Turpis (L.), *foul;* turpitude.
Twegen (S.), *two;* twain, between.

Uber (L.), *rich, fruitful;* exuberant.
Ubique (L.), *everywhere;* ubiquity.
Ultimus (L.), *last;* ultimately, penultimate.
Umbra (L.), *a shade;* umbrella, umbrage, umbrageous.
Unda (L.), *a wave;* inundate, undulating, abound.
Unguo, unctum (L.), *I anoint;* unguent, unction, anoint.
Unus (L.), *one;* union, unite, uniform, universe, unison, unicorn, unit, unique, trinity.
Urbs (L.), *a city;* urbane, suburb.
Uro, ustum (L.), *I burn;* combustion.
Utor, usus (L.), *I use;* use, utility, abuse, usufruct, usury.
Uxor (L.), *a wife;* uxorious.

Vacca (L.), *a cow;* vaccinate.
Vaco (L.), *I am unoccupied;* vacant, vacate, evacuate, vacuum.
Vado (L.), *I go;* evade, invade.
Vagor (L.), *I wander;* vagrant, vagabond, extravagant.
Valeo (L.), *I am strong or well;* valid, valetudinarian, prevail, convalescent, value, valedictory.
Vallum (L.), *a rampart;* wall, circumvallation.
Vanus (L.), *empty;* vain, vanish.
Vapor (L.), *steam;* vapour, evaporate.
Varius (L.), *different;* various, variegate.
Vasto (L.), *I lay waste;* devastate.
Vates (L.), *a prophet;* vaticinate.
Veho, vectum (L.), *I carry;* vehicle, convey, convex.
Vello, vulsum (L.), *I pull;* convulse.
Velox (L.), *swift;* velocity.
Velum (L.), *a covering;* veil, reveal.
Venenum (L.), *poison;* venom.
Veneror (L.), *I honour;* venerate, venerable.
Venio, ventum (L.), *I come;* intervene, convene, event, avenue, revenue, convent, convenient.
Venter (L.), *belly;* ventriloquist.
Ventus (L.), *wind;* vent, ventilate.
Ver (L.), *the spring;* vernal.

Verbum (L.), *a word;* verb, adverb, verbal, proverb.
Vereor (L.), *I fear;* revere, irreverent, reverend.
Vergo (L.), *I incline;* verge, converge, diverge.
Vermis (L.), *a worm;* vermin.
Verto, versum (L.), *I turn;* convert, verse, version, universe.
Verus (L.), *true;* very, veracious, veritable.
Vestigium (L.), *a footstep;* vestige, investigate.
Vestis (L.), *a garment;* vest, vesture, invest.
Vetus, veteris (L.), *old;* veteran, inveterate.
Via (L.), *a way;* deviate, trivial.
Vicinus (L.), *a neighbour;* vicinity.
Vicis (L.), *a turn, change;* vicar, vice-president, viceroy, vicissitude, viscount.
Video, visum (L.), *I see;* provide, visible, vision, visit, evident.
Vinco, victum (L.); *I conquer;* invincible, convince, victory, vanquish.
Vindex (L.), *an avenger;* vindicate.
Vir (L.), *a man;* virile, triumvir.
Virtus (L.), *virtue;* virtue.
Vita (L.), *life;* vital.
Vitium (L.), *vice;* vice, vitiate.
Vito (L.), *I avoid;* inevitable.
Vitrum (L.), *glass;* vitreous.
Vivo, victum (L.), *I live;* revive, victuals, vivacious, survive.
Voco, vocatum (L.), *I call;* vocal, vocation, convoke, advocate.
Volo (L.), *I wish;* volition, malevolent, benevolent, voluntary.
Volvo, volutum (L.), *I roll;* revolve, voluble.
Voro (L.), *I devour;* voracious, devour, carnivorous.
Voveo, votum (L.), *I vow;* vow, vote, devote.
Vulgus (L.), *the common people;* vulgar, divulge.
Vulnus, vulneris (L.), *a wound;* vulnerable.

Witan (S.), *to know;* wit, unwittingly.

Zōnē (Ζωνη, Gr.), *a girdle;* zone.
Zōon (Ζωον, Gr.), *an animal;* zoology, zodiac.

VI. PERIODS OF THE ENGLISH LANGUAGE.

The history of the English language, taking its rise at the arrival of the Saxons in England, is usually divided into four periods :—

(1) **Old English, or Anglo-Saxon,** from 450 to 1100 A.D.
(2) **Early English, or Later Saxon,** from 1100 to 1250 A.D.
(3) **Middle English,** from 1250 to 1485 A.D.
(4) **Modern English,** from 1485 to the present time.

(1) OLD ENGLISH, or ANGLO-SAXON.

This language was introduced, as we have seen, by the tribes of Saxons who conquered England during the fifth and succeeding centuries. The classical dialect of Anglo-Saxon was the West-Saxon ; but our modern English is supposed to have sprung chiefly from the East Midland. The principal writers during this period were :—

Cædmon, a monk of Whitby, who lived about 670 A.D. He wrote a long poem consisting of a *Paraphrase of Scripture History* contained in the Old and New Testament.

Alfred the Great, King of England (849–901). He translated several works into English ; as, Boëthius's *Consolation of Philosophy*, Pope Gregory the Great's *Pastoral Rule*, Bede's *History of England*, and the *History* of Orosius. He also assisted in translating the Bible.

Ælfric, Archbishop of Canterbury in the latter part of the tenth century. His writings are chiefly *Homilies* or *Sermons*.

A long poem of several thousand lines containing an account of the romantic adventures of Prince *Beowulf* still exists, but its author is unknown. It was probably written in the sixth century.

An *Anglo-Saxon* or *English Chronicle*, ascribed to various hands, contains the history of England from the arrival of Julius Cæsar till the accession of Henry II. It was probably partly written during this period.

Venerable Bede and other learned men wrote in Latin.

The following are short specimens of the Anglo-Saxon of this period. (The peculiar Saxon letters are modernized.)

(*a*) *From Alfred's Translation of Boëthius.*

Hit gelamp gio thætte an hearpere wæs on thære theode the Thracia hatte, sio wæs on Creca rice; se hearpere wæs swithe ungefræglice god, thæs nama wæs Orfeus, he hæfde an swithe ænlic wif, sio wæs haten Eurydice.	It happened formerly that a harper (there) was in the nation which Thrace was called, which was in Greece a kingdom; the harper was very incredibly good, his name was Orpheus, he had a very excellent wife, which was called (hight) Eurydice.

(*b*) *From Cædmon's Paraphrase of Scriptura.*

Noe hæfde	Noah had,
sunn Lameches	son of Lamech,
syx hund wintra	six hundred winters (years)
tha he mid bearnum	when he with (his) bairns
under bord gestah,	under board entered
gleaw mid geogothe	the wise (man) with the young
be Godes hæse.	by God's behest.

(2) **EARLY ENGLISH, or LATER SAXON** (1100–1250).

During most of this period the Saxon and Norman languages remained distinct, but the former underwent some changes in spelling and grammar. Towards the end of the period the two languages began to be blended with each other; the Normans became accustomed to use the Saxon language, and many Norman words were introduced into it.

The Saxon literature of this period is very meagre. It is chiefly represented by the English Chronicle before mentioned, and by the works of the following authors :—

Layamon, a priest of Warwickshire, who lived in the beginning of the thirteenth century. He wrote a poem called the *Brut*, or Chronicle of Britain, describing the foundation of the

British monarchy by Brutus, great grandson of Æneas. It contains about 32,000 lines.

Ormin, a monk who lived in the beginning of the thirteenth century, and wrote a poem called the *Ormulum*, a metrical version of portions of the New Testament, with lengthy explanations and comments.

The following lines from the *Ormulum* will serve as a specimen of the English of this period (the peculiar Early English letters are modernized).

And me ice wile shæwen yuw	And now I will shew you,
Summ-del, with Godess hellpe,	Somewhat, with God's help,
Off thatt Judisskenn folkess lac	Of that Jewish folks offering,
Thatt Drihhtin wass full cweme,	That was to the Lord full pleasing,
And mikell helpe to the follc,	And much help to the people,
To laered and to laewedd,	To learned and to unlearned,
Biforen thatt te Laferrd Crist	Before that the Lord Christ
Was borenn her to manne.	Was born here to men.

(3) MIDDLE ENGLISH (1250–1485).

During this period the language lost many of its inflections, received weak instead of strong forms of the verbs, adopted a great number of Norman-French words, and became similar in most essential points to the English of the present day. The chief writers of this period were :—

Sir John Mandeville (1300–1371), the first writer of distinctively English prose, was a man of a liberal education, and a doctor by profession. He travelled in eastern countries, and on his return published an account of his travels, first in Latin, then in French, and lastly in English. This work is a curious mixture of plain facts with fabulous tales founded on old legends and marvellous eastern stories. The following is a specimen of his English :—"Machomete wente into a chapelle where a eremyte [hermit] duelte. And whan he entred into the

chapelle, that was but a lytille and a low thing, and had but a lityl dore and a low, than the entree began to wexe so gret and so large and so high, as though it had ben of a gret mynstre, or the yate [gate] of a paleys [palace]."

William Langley (or **Langland**), a priest who lived in the middle of the fourteenth century. He wrote a long allegorical poem called the *Vision of William concerning Piers the Ploughman*, which describes the author as falling asleep on the Malvern Hills, and seeing visions in which Piers the Ploughman appears to him. During the progress of the allegory the author, in vigorous English of that period, denounces the vices of society during the times in which he lived. Various characters are introduced, chiefly personifications of virtues, vices, and other abstract notions; such as Reason, Truth, Anima (the soul), Covetousness, Envy, etc. By means of these allegorical personifications he fiercely attacks the dissolute lives of the ecclesiastics and the corruptions of society in general. This poem is supposed to have occupied the author about thirty years in its composition. It is a work of high literary merit, and most valuable as illustrating the growth of the English language and presenting a lively picture of the social life of the period. The following are the opening lines of the poem :—

"In a somer sesun, whon softe was the sonne,
I schop me into a schroud, a scheep as I were;
In habite of an hermite, vn-holy of werkes,
Wende I wydene in this world, wondres to here."

VOCABULARY.—*Somer*, summer. *Sesun*, season. *Schop*, put. *Schroud*, garment. *Scheep*, shepherd. *Wende*, went. *Wydene*, wide, far.

Robert of Gloucester was a monk of Gloucester Abbey, who lived in the reign of Edward I. He wrote a *Rhyming Chronicle* of the history of England from the siege of Troy till his own times. This work is written in long lines resembling the Alexandrine verses of modern English.

Geoffrey Chaucer (1340–1400), a poet who flourished in the reigns of Edward III. and Richard II., and is usually regarded as the father of English poetry. He was a friend of John of Gaunt, and a favourite at the court of Edward III. He took part in the war with France, during which he was made prisoner, but was afterwards ransomed. He was employed on diplomatic missions abroad, and appointed to various remunerative offices in England. In the reign of Richard II. his fortunes declined. He died soon after the accession of Henry IV., by whom he had been again taken into favour.

His poems are works of high literary merit. They exhibit great powers of description, and of quaint and quiet humour. In the art of telling a story, Chaucer has never been surpassed. His principal work is the *Canterbury Tales*, a series of stories supposed to be related by a company of pilgrims travelling from the Tabard Inn, in Southwark, to visit the shrine of Thomas à Becket at Canterbury. He also wrote *The Flowe and the Leaf*, *The House of Fame*, and other beautiful descriptive poems.

Chaucer polished our language and fitted it for the purposes of the highest literary work. He introduced many new words from the Norman-French, and thus greatly enriched the English vocabulary. For this he was unjustly accused by some of his contemporaries of debasing the language by the addition of a foreign element.

The following lines are taken from the *Canterbury Tales* :—

"A Knight ther was, and that a worthy man,
That fro the time that he firste began
To riden out, he loved chevalrie,
Trouthe and honour, freedom and curtesie.
Ful worthy was he in his lordes werre,
And thereto hadde he ridden, no man ferre,
As wel in Christendom as in Hethenesse,
And ever honoured for his worthinesse."

VOCABULARY.—*Fro*, from. *Trouthe*, truth. *Werre*, war.

Ferre, farther, comparative of *fer*, far. *Hethenesse*, heathen countries.

John Gower was a contemporary of Chaucer. He was a man of good family, received a liberal education at Merton College, Oxford, and adopted the legal profession. He wrote a poem in French, another in Latin, and a third, called *Confessio Amantis* (the Lover's Confession) in English. It is a highly moral, but rather dull work, and is vastly inferior to the poems of Chaucer.

John Wickliffe (1324–1384), the famous English reformer, was educated at Oxford, where he became Master of Balliol College. In 1374 he was made Vicar of Lutterworth, in Leicestershire, where he continued to preach till his death. For denying the doctrine of transubstantiation, and holding opinions which were deemed heretical, he fell under the censure of the Pope, and of his ecclesiastical superiors in England. Through the powerful protection of his friend, John of Gaunt, he however remained unmolested till his death, of paralysis, in 1384.

As a writer Wickliffe is chiefly known by his translation of the Bible, which affords a valuable illustration of the English of that period. The following is a specimen of this work :— "Thanne the kyngdom of heavenes shal be lic to ten virgyns, the whiche, takynge her lampis, wente out meetynge the spouse, and the spousesse."

John Barbour, an archdeacon of Aberdeen who lived during the latter half of the fourteenth century, wrote a long poem, in rhyming couplets, called *The Bruce*. It gives an account of the adventures of King Robert Bruce, and the wars by which he secured the independence of Scotland.

(4) MODERN ENGLISH (1485 to the present time).

This period might be divided into others corresponding nearly with those of the reigning families of England. Thus we should have the Tudor Period, the Stuart Period, and the Hanoverian Period. The following is a list of the chief writers, with their principal works :—

William Caxton (1422–1491), who lived during the end of the Middle English and the beginning of the Modern English periods, is celebrated as the introducer of printing into England. The first book printed in the English language was the *Recuyell of the Histories of Troye*, a translation from a French work, printed by Caxton at Ghent, 1474. The first book printed in England was probably the *Dictes and Notable Wise Sayings of the Philosophers*, published in 1477, though some authorities claim this honour for the *Game and Playe of the Chesse*. Caxton brought out about a hundred different publications.

William Dunbar (1460–1520), one of the greatest of Scotch poets, wrote *The Thistle and the Rose*, and other poems characterized by great powers of humour, description, and imagination.

Gawyn Douglas (1474–1522), bishop of Dunkeld, translated Virgil's Æneid into Scottish verse. This work is remarkable as the first translation of a Latin classic published in Britain.

Sir Thomas More (1480–1535). A celebrated statesman and author during the reign of Henry VIII. He succeeded Wolsey as Lord Chancellor, but having refused to acknowledge the king's ecclesiastical supremacy, was tried for high treason and executed, 1535. He was a man of great ability and upright character, though not free from the religious intolerance of the period in which he lived. He wrote, in Latin, a celebrated work called *Utopia* (signifying in Greek, *no-land*), giving an account of an imaginary model Republic, in which everything was good and happy.

William Tyndale (1477–1536); published a translation of the New Testament in 1525. The following verse taken from this translation will illustrate the English of his time :—"Then the kyngdom of heven shal be lykened vnto x virgins, which toke their lampes, and went to mete the brydgrom."

The Earl of Surrey (1517–1547); introduced blank verse and the sonnet into English poetry.

Sir David Lindsay (1490–1557), a Scotch poet; wrote *The Satyre of the Three Estates*, and other satirical poems.

John Foxe (1517–1587) wrote a famous work entitled *History of the Acts and Monuments of the Church*, popularly known as Foxe's Book of Martyrs.

John Stow (1525–1605) and **Raphael Holinshed** (dates uncertain) were two "old chroniclers" who wrote annals of English history in prose. The narrative of the latter was much used by Shakspere as the materials for composing his English historical dramas.

Roger Ascham (1515–1568); tutor to Lady Jane Grey and Queen Elizabeth. He lived in the reigns of Henry VIII., Edward VI., Mary, and Elizabeth. He wrote *Toxophilus*, a treatise on archery, and *The Schoolmaster*, an educational work.

John Lyly; flourished in the reign of Elizabeth. He wrote *Euphues, the Anatomy of Wit*, composed in an affected style which gained for him the name of the Euphuist.

Sidney, Sir Philip (1554–1586). Born at Penshurst, in Kent; educated at Shrewsbury and Oxford. He was the most accomplished gentleman of his time, the model of a perfect knight, "*Sans peur et sans reproche*," and a great favourite with Queen Elizabeth, who called him "the brightest jewel of her court." He was employed by her on various missions abroad, and took part in the expedition to the Netherlands. He fell mortally wounded at the battle of Zutphen, 1586. When dying, and parched with thirst, he is said to have given the cup of water which he was about to drink to a poor wounded soldier, with the words, "Thy necessity is yet greater than mine." He wrote *Arcadia*, a romance, and a *Defence of Poesie*.

The English Drama began to be important in the early part of the period. As in most other countries, the drama in England had a religious origin. The earliest performances of the kind were **Miracles**, or **Miracle Plays**, representing scenes and histories taken from the Bible and brought out under the direction of the clergy. These were followed by **Moral Plays**, in which various allegorical personages, such as Justice, Mercy, etc., were introduced. Then histories of a secular kind, as well as tales and fables, were employed in the formation of the plot

and the dialogue, and the compositions began to assume the form of the ordinary Elizabethan drama.

The *Interludes* of **John Heywood**, a writer of the reign of Henry VIII., were a kind of dramatic entertainment, representing some farcical incident by means of dialogue and physical action. They show considerable powers of wit, humour, and sarcasm.

The first specimen of regular comedy now remaining is entitled *Royster Doyster*, written by **Nicholas Udall**, head master of Westminster School in the reign of Henry VIII. It is a highly amusing production, is divided into five acts, and contains no less than thirteen characters. The next is *Gammer Gurton's Needle*, said to have been composed about 1565, by **John Still**, afterwards Bishop of Bath and Wells. The plot is of a rude kind, turning on the loss of a needle by Gammer Gurton, but some of the characters are well sketched.

Our earliest known tragedy was written by **Thomas Sackville**, Earl of Dorset. It was performed before Queen Elizabeth, 1561–1562, and is entitled *Ferrex and Porrex*, or *Gorbeduc*. Its plot is founded on a legend taken from early British history. It is divided into five acts, and is written in regular blank verse. It is deficient in dramatic interest, but many of the speeches and particular lines exhibit considerable poetical talent.

Robert Greene, a dramatist who flourished in the reign of Elizabeth. He is now remembered chiefly for a work called *A Groat's Worth of Wit bought with a Million of Repentance*, which contains a contemporary allusion to Shakspere.

Christopher Marlowe, one of the most famous of the dramatists contemporary with Shakspere. He wrote *Tamburlaine the Great*, *Faustus*, *The Jew of Malta*, *Edward II.*, and other dramas. The last-named play is a fine work, and is generally regarded as the forerunner of Shakspere's historical dramas. His sonorous verse is praised by Ben Jonson, who describes it by the well-known phrase, "Marlowe's mighty line."

Edmund Spenser (1552–1599), one of England's greatest poets, the "poet's poet"; flourished in the reign of Elizabeth.

He was born in London, and educated at Pembroke Hall, Cambridge, as a sizar. He formed a close connection with Sir Philip Sidney and the Earl of Leicester, who employed him as his secretary. In 1580 he was appointed secretary to Arthur, Lord Grey of Wilton, lord-deputy of Ireland. He obtained a grant of 3,028 acres of land in the county of Cork, including the manor and castle of Kilcolman, confiscated from the property of Irish rebels. Here he wrote his great poem, the *Faërie Queene*, a work describing the deeds of various knights of chivalry, each of whom represents a cardinal virtue. It was dedicated to Queen Elizabeth, to whom the poet was introduced by Raleigh, and who is said to have been extremely pleased with the poem, and to have described it as of "wondrous worth." The poem is written in Spenserian stanzas, each consisting of nine lines of rhyme, the last being an Alexandrine. Byron's *Childe Harold* is composed in the same metre. Six cantos of the *Faerie Queene* still remain; six others are said to have been lost.

During the disturbances in Ireland, Spenser's castle was attacked by the rebels and burnt to the ground. He and his wife escaped, but their new-born babe perished in the flames. They with difficulty escaped to London, where Spenser died of a broken heart, in extreme poverty.

Besides the *Faerie Queene*, Spenser wrote the *Shepheard's Calendar*, a collection of pastoral poems or eclogues, one for each month in the year, in which he celebrates his love for a lady whom he had known in his youth, under the assumed names of Colin Clout and Rosalind; the *Tears of the Muses*, *Mother Hubberd's Tale* (a story of a fox and an ape), *Colin Clout's Come Home Again*, *Astrophel* (an elegy bewailing the death of Sir Philip Sidney), and *Sonnets*.

Richard Hooker, surnamed the "Judicious" (1553?–1600), a famous theological writer of the reign of Elizabeth. He is one of the best of our early prose writers, his style being marked by a purity, correctness, and force scarcely surpassed by any subsequent author. His chief work is *Ecclesiastical*

Polity, an elaborate defence of the principles of the Church of England against the attacks of the Puritans.

William Shakspere (1564–1616), England's greatest dramatist and poet, and the greatest literary genius of any age or country. He flourished in the reigns of Elizabeth and James I. He was born at Stratford-on-Avon (Warwickshire), where he was educated. He married Anne Hathaway, daughter of a yeoman, 1582. He went to London to seek his fortune. Having become connected with the stage, he became an actor and one of the proprietors of the Globe Theatre. After securing a comfortable competence, he retired to his native place, Stratford-on-Avon, where he died. During his connection with the theatres, and also while living quietly afterwards in his native town, he wrote his admirable dramas. The following is a list of his works :—

I. DRAMATIC WORKS.—These are about 37 in number, and may be divided into—

(*a*) *Tragedies* (which end in the death of the principal character): Hamlet, Romeo and Juliet, Othello, King Lear, Macbeth.

(*b*) *Comedies* (which end happily for the principal character): Comedy of Errors, Two Gentlemen of Verona, Love's Labour's Lost, Taming of the Shrew, Midsummer Night's Dream, All's Well that Ends Well, Merchant of Venice, Much Ado about Nothing, As You Like It, Merry Wives of Windsor, Twelfth Night, Measure for Measure, Winter's Tale, Cymbeline, The Tempest.

(*c*) *Historical Plays* (founded on events in English and Roman History): Henry VI. (in three parts), King John, Richard II., Henry IV. (in two parts), Richard III., Henry V., Henry VIII., Antony and Cleopatra, Julius Cæsar, Coriolanus. Some of these are also tragedies.

(*d*) *Mixed Plays* (partly Historical): Troilus and Cressida, Timon of Athens.

(*e*) *Doubtful Plays* (probably only partly composed by Shakspere): Pericles, Titus Andronicus. Several other plays which

have been attributed to Shakspere are rejected as spurious by the best authorities. The genuineness of the first two parts of Henry VI. has been much disputed.

II. POEMS.—These consist of—

(*a*) *Sonnets*, in number 154.

(*b*) *Venus and Adonis*, supposed to have been Shakspere's first composition.

(*c*) *Lucrece*, a Roman Story.

(*d*) *A Lover's Complaint.*

(*e*) *The Passionate Pilgrim*, a collection of short poems, of which probably only a few are from Shakspere's pen.

The chief characteristics of Shakspere's genius are :—

(*a*) *Power of Delineating Character.* Throughout his plays we meet with personages of all kinds, all ages, and all ranks, each being a distinct individual set before us as a real living being, with whom we become as well acquainted as with the persons we meet with in the daily intercourse of life. Shakspere seems to have the power of understanding the human heart and intellect in its minutest details, and to be able at will to create characters displaying every shade of human thought and feeling. No real persons are better known to us than Sir John Falstaff (in Henry IV. and V.), Shylock (in the Merchant of Venice), Hamlet, Lady Macbeth, Othello, Iago (in Othello), Bottom (in A Midsummer Night's Dream), and King Lear. So completely does Shakspere cast aside his own individuality, and merge himself in the personages he describes, that we learn absolutely nothing of the life or tastes of the author himself from his plays.

(*b*) *Universality.* This is connected with the preceding quality. Shakspere is the great poet of nature and human life. He seems to understand everything by a kind of intuition. Dryden says he was the "man who, of all modern, and perhaps ancient, poets, had the largest and most comprehensive soul. All the images of nature were still present to him, and he drew them not laboriously but luckily; when he describes anything, you more than see it, you feel it too. Those who accuse him

to have wanted learning, give him the greater commendation: he was naturally learned: he needed not the spectacles of books to read Nature: he looked inwards, and found her there."

(*c*) *Humour.* This is displayed in many characters and incidents scattered through his plays. His fools are not mere insipid simpletons, they "tickle our very souls," as Carlyle says. We smile at the very remembrance of Sir John Falstaff, of Bottom the weaver, of Dogberry and Verges, and of the numerous entertaining situations in which they are the central figures.

(*d*) *Imagination and Fancy.* Shakspere not only drew characters resembling those of human life.

> "Each change of many-coloured life he drew,
> Exhausted worlds, and then imagined new."

He had the power of placing before us with the most extraordinary vividness, consistency, and apparent truth, beings removed from the ordinary experience of mankind. The witches in Macbeth, the fairies in the Midsummer Night's Dream, and the spirits in the Tempest, talk and act in such an apparently natural and consistent manner, and are drawn with such wonderful art, that it seems impossible to doubt the reality of their existence.

(*e*) *Poetical Power.* Shakspere has never been surpassed in the poetic art. His works abound with beautiful passages which, even when injured by being removed from the context, can be read with the greatest pleasure and admiration. The passage on "Mercy" in the Merchant of Venice, that on "Queen Mab" in the Midsummer Night's Dream, that on the world being like a stage in As You Like It, together with hundreds of others which might be named, form a collection of beautiful gems of poetry which could not be equalled by extracts from any other poet ancient or modern.

William Camden (1551–1623), eminent as an antiquary and an historian. His chief work is *Britannia*, originally written in Latin, but an English translation appeared during the author's lifetime. It contains a minute account of the British Islands.

Authorized Translation of the Bible. In 1611 a new translation of the Bible appeared. This was the most important result of the Hampton Court Conference, which met to consider the troubles and dissensions which afflicted the Church of England. It was undertaken by fifty-four learned divines, of whom seven died during the four years devoted to its preparation. When it appeared, its superiority to all previous versions made itself evident, and it soon took up a position as the standard English translation of the Bible, and has retained it till the present time. Probably no other works, not even the writings of Shakspere, have had such an influence in establishing the English language on a firm and settled basis.

A Revision of the translation of the New Testament has lately appeared, 1881. Much diversity of opinion exists with regard to the merits of this revision, but it seems to be generally admitted that it is not likely to supersede the old version as a specimen of clear, harmonious, and idiomatic English.

George Chapman (1557–1634) was a dramatist and a translator of Homer. His version of the Greek poet is written in long lines of fourteen syllables each. It is still highly esteemed by literary men.

Michael Drayton (1563–1631) was the author of the *Polyolbion*, a curious topographical poem written in Alexandrine lines, and giving a minute description of England.

Ben Jonson (1573–1637), next to Shakspere the most famous of the dramatists of the reigns of Elizabeth and James I. He is said to have been born at Westminster, and was educated at the famous school of that city. According to tradition he worked as a bricklayer, and then served as a soldier in the Netherlands. He afterwards attempted to gain a livelihood as an actor, but did not succeed. He then commenced writing plays for the stage, and after a time met with much success. Jonson was a friend and intimate companion of Shakspere, with whom he had many friendly contests of wit at the "Mermaid" tavern in Bread Street. He is said to have been a hard drinker, and to have brought himself to want and shortened his days through frequent indulgence in liquor.

Jonson's plays are not now much read, and are seldom acted. They display much learning, but it is of a ponderous and pedantic kind. Jonson wanted the lightness, facility, and imagination of Shakspere, though some of his best plays exhibit great skill in the construction of a plot, considerable powers of humour, and much poetic skill. His best plays are :—*Every Man in His Humour*, *Volpone* (or the Fox), and *The Alchemist*. Other dramas are :—*Every Man out of His Humour*, *Sejanus*, *Catiline*, *Cynthia's Revels*, *The Poetaster*, *Epicœne* (or the Silent Woman), and *Bartholomew Fair*. He wrote many Masques for the entertainment of the Court of James I.

Francis Beaumont (1586–1615) and **John Fletcher** (1576–1625) were two dramatists who wrote plays conjointly. They wrote no less than fifty-two dramas, some of considerable merit. The influence of Shakspere is apparent through most of them. The best known are :—*Philaster*, *The Maid's Tragedy*, and *The Two Noble Kinsmen*. Shakspere is said to have assisted them in the composition of the latter ; his name appears with theirs on the title-page of the first edition. After Beaumont's death Fletcher produced several dramas by himself. Of these, *Rule a Wife and Have a Wife* is the most celebrated.

Philip Massinger (1584?–1640) was another eminent dramatist of the same period. Of a large number of plays, eighteen have come down to us, and some still keep possession of the stage. Among them may be mentioned :—*The Virgin Martyr*, *The Bondman*, *The City Madam*, *A New Way to Pay Old Debts*, and *The Maid of Honour*.

Other dramatists of the same time were **John Ford**, **John Webster**, **Thomas Heywood**, and **James Shirley**.

Francis Bacon (1561–1626), one of the greatest of England's authors and philosophers. He flourished in the reigns of Elizabeth and James I. He was born in London, and distinguished himself in his early years by great powers of intellect. After being educated at Cambridge, he commenced the study of the law. He rose in his profession, and in 1593 sat in Parliament for Middlesex. He has been accused of ingratitude towards

his friend the Earl of Essex, by appearing as counsel against him, and exerting himself to the utmost to obtain a conviction. After attaining to various degrees of preferment, he was created Lord High Chancellor of England and Lord Verulam, in 1619. Two years afterwards he was accused of taking bribes, and a Parliamentary committee was appointed to inquire into his conduct. Being found guilty by his own confession, he was degraded from his high office, and fined. He spent the rest of his life in literary and philosophical labours.

He is chiefly famous as the author, or rather the expounder, of Induction, a method of philosophical research depending on careful investigation and patient experiment. His philosophical system is explained in *The Advancement of Learning*, and in his great work *Instauratio Scientiarum*, consisting of two parts, *De Augmentis Scientiarum* and *Novum Organum*, both written in Latin.

He also wrote *Essays* on such familiar topics as Truth, Counsel, Gardens, Studies, Youth and Age, and other matters which, as he says, "come home to men's business and bosoms." This work is a masterpiece of plain common-sense written in clear, forcible, and elegant English. Other works of Bacon are:—*Of the Wisdom of the Ancients*, *Felicities of Queen Elizabeth's Reign*, a *History of King Henry VII.*, and a philosophical romance entitled the *New Atlantis*.

John Selden (1584–1654), a prose writer, chiefly remembered for his *Table Talk*, a collection of his sayings, published after his death.

George Herbert (1593–1632), a quaint but pleasing religious poet of the early part of the seventeenth century. His principal work, *The Temple; or, Sacred Poems and Private Ejaculations*, was published the year after his death.

Robert Burton (1576–1640) was a clergyman of the sixteenth and seventeenth centuries, now chiefly remembered for a quaint and original work called the *Anatomy of Melancholy*. It abounds with quotations gathered from many sources, chiefly ancient and obscure authors. It was very popular during the

lifetime of the author, and still has many readers. Dr. Johnson said that it "was the only book that ever took him out of bed two hours sooner than he wished to rise."

James Usher (1586–1656), Archbishop of Armagh. He was famous for his great learning, and for many works on theological subjects. He is now chiefly known by his system of biblical chronology.

Thomas Hobbes (1588–1679) is one of our greatest writers on political philosophy. He was at one time in high favour with the Prince of Wales, afterwards Charles II., who was then a refugee in France; but his works offended the royalists, and Hobbes left the country. Though frequently in danger from political foes, he lived to the advanced age of ninety-one. His great work is the *Leviathan*, in which he expounds his views with regard to the constitution of a limited monarchy, based on the administration of just laws.

Isaac Walton (1593–1683), author of *The Complete Angler*, a pleasing work written in the form of a dialogue in prose.

Jeremy Taylor (1613–1667), a great preacher and religious author, who flourished during the reign of Charles I., the Commonwealth, and the reign of Charles II. He was a zealous supporter of the royal cause, and Charles II. made him an Irish bishop (of Down and Connor). His chief works are:—*Liberty of Prophesying*, *The Great Exemplar*, *Holy Living*, *Holy Dying*, *Golden Grove*. All his works are characterized by a rich and glowing eloquence, and display the utmost beauty of language filled with piety, fervour, and devotion. They still keep their ground, and are great favourites with pious members of the English Church, and of other religious bodies.

John Milton (1608–1674), the second greatest English poet. He was born in London, educated at St. Paul's School, and afterwards at Christ's College, Cambridge. He travelled; then, returning to England, took pupils in his house in London. He espoused the cause of the Parliament in the disputes with the king, and wrote several treatises in favour of popular liberty. On the establishment of the Commonwealth, 1649, he was appointed

Foreign Secretary. His great literary exertions brought on blindness, but he continued his labours till the end of his life. At the Restoration he was in danger of being punished, but his friends obtained his pardon with some difficulty.

Milton is one of our greatest writers, both in prose and in poetry. His prose style is full, vigorous, musical, and wonderfully expressive. It is formed on classical models, which Milton's immense learning induced him to follow to a large extent; but he is no slavish imitator. His prose writings contain some of the most splendid and eloquent passages in the English or in any language. They are not, however, so much read as their great merit, both as to style and matter, deserve. Milton's chief prose works are:—*Areopagitica, a Speech for the Liberty of unlicensed printing to the Parliament of England*—a work which places Milton in the highest rank among the most eloquent champions of civil and religious liberty; a *Tractate on Education;* two or three publications on *Marriage and Divorce; Iconoclastes*, a vigorous reply to the celebrated work called "Ikon Basilike," sometimes attributed to Charles I.

Milton's fame as a prose writer is, however, eclipsed by that which he has obtained as a poet. His poetry has gained for him the second place in English literature, and the reputation throughout the world of being one of the greatest poets who ever lived. He excels in sublimity of thought, and a wonderful power of using words with unrivalled felicity to express the nicest gradations of meaning, combined with a singular harmony of versification. He was a great scholar, well versed in classical literature; hence his style is full of words and expressions derived from Latin and Greek models, but made his own by his marvellous command of language.

His chief poems are the following:—(*a*) *Paradise Lost*, an epic poem describing the Fall of Man. This is the finest effort of Milton's genius, and is generally regarded as the greatest poem in the English language. Many of the descriptions of Heaven and Hell are of the sublimest kind, while the beautiful

pictures of the tranquil scenes of Eden, and the happiness of our first parents, offer a perfect contrast to the former both in ideas and style. This noble poem is written in blank verse, of the most varied and harmonious kind, exhibiting the most perfect command over all the resources of the English language. (*b*) *Paradise Regained*, a sequel to *Paradise Lost*, also written in blank verse. Here, again, we find the author most successful in the effects produced by a happy choice and combination of words. The poet is said to have preferred this work to his great epic poem; but his opinion is at variance with that of posterity. (*c*) *Samson Agonistes*, a dramatic poem, founded on the Greek model, and relating to the sufferings and death of Samson. (*d*) *Comus*, a mask, founded on a mythological story. (*e*) *L'Allegro* and *Il Penseroso*, two descriptive poems. (*f*) *Lycidas*, a monody on the death of a friend. (*g*) *Sonnets*, *Odes*, and miscellaneous poems.

Milton also wrote works in Latin, and some small poems in Italian.

Sir Thomas Browne (1605–1682), a scholar and prose writer; author of *Religio Medici* (The Religion of a Physician) and a treatise on *Urn-Burial*.

Edmund Waller (1605–1687), an almost forgotten poet, contemporary with Milton. He was in favour both with Oliver Cromwell and with Charles II.

Samuel Butler (1612–1680) is now famous chiefly for a long satirical poem called *Hudibras*, formed after the model of "Don Quixote." The object of the poem is to ridicule the peculiarities of the Puritans. The hero, Hudibras, is made to pass, in company with his squire Ralpho, through a series of adventures in which his folly is displayed in a striking manner. The poem is written in rhyming couplets, with four iambic feet to each line. It exhibits an inexhaustible amount of wit; the reader, indeed, tires of the never-ceasing flow of clever conceits and images, and longs for something more allied to nature.

Thomas Fuller (1608–1661), author of the *Worthies of England;* **Dr. Isaac Barrow** (1630-1677), **John Tillotson** (1630–

1694), and **Dr. Robert South** (1633–1716) were learned and eloquent divines of the Church of England. **Richard Baxter** (1615–1691), an eminent Nonconformist divine, was the author of the *Saint's Rest*, and other works still highly esteemed by readers of various religious opinions.

John Denham (1615–1668) was the author of *Cooper's Hill*, a descriptive poem written in heroic couplets. The versification is smooth, and Pope praises the "strength of Denham." The poem was once very popular, but it is now seldom read as a whole. The verses describing the river Thames have often been quoted and admired.

Abraham Cowley (1618–1667) was a poet of the reign of Charles II., who once had an immense reputation, which has now almost entirely disappeared. He wrote part of an epic poem, the *Davideis*, and a number of miscellaneous pieces, composed in the artificial style of the period of the Restoration.

Andrew Marvell (1620–1678), a distinguished patriot and polished satirist of the time of the Commonwealth.

John Dryden (1631–1700), a poet and dramatist who flourished in the reigns of Charles II., James II., and William III. He was born at Aldwinckle, in Northamptonshire, and was educated at Westminster School, and afterwards at Trinity College, Cambridge. He went to London on leaving the University, and soon became famous as a poet. His poems in celebration of the Restoration gained him the favour of Charles II., and he was made poet-laureate, with a salary of £200 a year. Dryden became the acknowledged head of English literary men, and retained this pre-eminence till his death. After the accession of James II., he became a Roman Catholic, and has been accused of interested motives for this change of faith. At the Revolution he was deprived of his pension, and was obliged to support himself by the writing of plays. He died in 1700, and was buried in Westminster Abbey.

Dryden is still regarded as one of our greatest poets. His versification is almost perfect—strong, clear, and harmonious. In satirical verse he is still unrivalled among English authors,

nor would it be easy to find his equal in this particular field among the writers of any age or nation. In dramatic literature he was less successful. He wanted the dramatic faculty, and he has rendered himself ridiculous by an absurd attempt to improve Shakspere. His dramas, which are deeply tinged with the licentious character of the period, have fallen into well-deserved oblivion.

Dryden's chief poetical works are :—*A Translation of Virgil*; *Absalom and Achitophel*, a political satire on some of the chief personages of the day ; *The Hind and the Panther*, a religious satire extolling the Church of Rome at the expense of the Church of England and the Nonconformist bodies ; *Fables*, a series of tales borrowed from Chaucer, and admirably versified ; *Alexander's Feast*, one of the finest odes in the English language ; and an *Ode for St. Cecilia's Day*, written in praise of Music.

Dryden was also a master of prose style ; for clear and forcible English his prefaces and his *Essays on Dramatic Poesy* have seldom been surpassed.

Edward Hyde, Earl of Clarendon (1608-1674), chief minister of Charles II.; wrote a *History of the Rebellion*, which once had a great reputation, and is still consulted by historians.

John Bunyan (1628-1688), a religious author of the seventeenth century, wrote one of the most popular books in the world, the *Pilgrim's Progress*. He was born at Elstow, near Bedford, and was brought up to his father's trade of a tinker. After internal conflicts of the most distressing kind, he became a man of deep religious convictions and took to preaching, but was cast into prison for not conforming to the established religion. While in Bedford jail he wrote the *Pilgrim's Progress*. After being imprisoned for twelve years, he was at length released through the intervention of the Bishop of Lincoln, and at once recommenced his labours as a preacher, and continued them till his death in 1688.

The *Pilgrim's Progress* is an allegory, relating in simple language the life of a Christian, which he describes as a journey

from the City of Destruction to the Heavenly Jerusalem. Of this work, Lord Macaulay says:—"There is no book in our literature on which we would so readily stake the fame of the old unpolluted English language, no book which shows so well how rich that language is in its own proper wealth, and how little it has been improved by all that it has borrowed"; and, "Though there were many clever men in England during the latter half of the seventeenth century, there were only two minds which possessed the imaginative faculty in a very eminent degree. One of those minds produced the *Paradise Lost* the other the *Pilgrim's Progress*."

Bunyan also wrote:—*The Holy War*, an allegory representing the spiritual conflict between the soul of man and Satan; and *Grace Abounding*, an autobiographical work describing his own early life, and the mental struggles through which he passed before finding peace.

John Locke (1632–1704), a celebrated philosophical writer of the reigns of Anne and William III., was educated at Westminster School, and Christ Church, Oxford. His opposition to the tyranny of James II. brought him into trouble, and he had to fly from the country to avoid prosecution on a charge of high treason. He returned to England after the Revolution of 1688, and gained great favour at the court of William III., by whom his great abilities were highly appreciated.

His chief production is an *Essay on the Human Understanding*, a book which still maintains a high position among metaphysical works. He also wrote a smaller essay *On the Conduct of the Understanding*, a work on *Education*, and several other books.

Sir Isaac Newton (1642–1727) is known rather as the greatest of natural philosophers, and one of the greatest of mathematicians, than as an English author. He was born at Woolsthorpe, Lincolnshire. His father was a farmer. He was educated at a private school in Grantham, and afterwards at Cambridge. He made great discoveries in mathematics, optics, astronomy, and other branches of natural philosophy. His life was almost

entirely that of a student, and he rarely took part in public events. During the reign of James II. he formed one of the deputation sent by the fellows of Cambridge to the Government to protest against the infringements of the privileges of the University. In 1680 he represented the University in Parliament. He died at Kensington, at the age of eighty-four, and was buried in Westminster Abbey.

His chief work, written in Latin, is *Philosophiæ Naturalis Principia Mathematica*, commonly called shortly the *Principia*, containing his views concerning gravitation and its effects in regulating the movements of the solar system. He also wrote works on geometry and optics, as well as several theological treatises.

Thomas Otway (1652–1685), a once famous dramatist, whose works abound in pathetic scenes. *Venice Preserved* and *The Orphan* are the plays by which he is best known.

Joseph Addison (1672–1719), born at Milston, in Wiltshire. After receiving some tuition in the country, he was sent to Charterhouse School, in London, where he became acquainted with **Sir Richard Steele** (1671–1729), in conjunction with whom he afterwards issued the *Tatler*, *Spectator*, and *Guardian*, three famous periodical publications of Queen Anne's reign. In 1687 he was sent to Oxford, and gained his degree of M.A. at Magdalen College, 1693. His poetry soon attracted attention, and he obtained a pension of £300 a year from the Crown to enable him to travel, with a view to his being employed in the diplomatic service. His pension ceased on the death of William III. His poem of *The Campaign*, describing the victories of the Duke of Marlborough in the war of the Spanish Succession, made him famous. In 1706 he was appointed Under-Secretary of State. He held various offices under the Government from time to time, and published many famous literary works, all characterized by a quiet and graceful style peculiarly his own. In 1717 he became Secretary of State, but soon after retired with a pension. He died at Holland House, Kensington, 1719.

Addison was the contemporary of Pope, with whom he divided the literary pre-eminence of their time. He was far inferior to Pope as a poet, but was much superior to him in prose. Dr. Johnson says: "Whoever wishes to attain an English style, familiar but not coarse, and elegant but not ostentatious, must give his days and nights to the volumes of Addison."

His chief works are papers in the *Spectator*, *Tatler*, and *Guardian*; *The Campaign*, mentioned above; *Cato*, a tragedy written on the French model, regular in plan, and possessing considerable merit as a poetical composition; and *The Drummer*, a comedy.

Daniel Defoe (1661–1731) spent the earlier part of his literary life in writing periodical pamphlets in favour of religious liberty. In 1701 he issued a satirical poem, *The True-born Englishman*, to defend the character and policy of William III. It had an immense success. In 1702 he published an ironical work, *The Shortest Way with the Dissenters*, which professed to advocate a rigid suppression of Nonconformists, while it was in fact a bitter satire on their persecutors. For writing this work he was thrown into the pillory, fined, and imprisoned. In prison he wrote a *Hymn to the Pillory*. After a short period of prosperity, his free and independent spirit again brought him into trouble, and he was cast into Newgate. The rest of his life was spent in labours more purely literary.

The work for which Defoe is best known is *Robinson Crusoe*, in which he relates the life of a man cast away on a desert island, with such minuteness of detail, and such an air of truth, that the effect is simply marvellous. He also wrote *Moll Flanders*, *A Journal of the Plague*, *Colonel Jack*, and several other fictions, all composed in the same plain and simple but effective style as *Robinson Crusoe*.

John Gay (1688–1732) was the author of a volume of *Fables*; *Trivia*, or the Art of Walking in the Streets of London; and various plays. His famous *Beggar's Opera*, a comic musical drama, is still well known and is occasionally performed on the stage.

Alexander Pope (1688–1744) was the most famous poet of his age, and his writings still hold a high place in English literature. He was the son of a retired linen-draper, and becoming possessed of a comfortable income on the death of his father, he took a house and lands at Twickenham, where he lived during the rest of his life, spending his time in the cultivation and adornment of his residence and grounds, and in the pursuit of literature. Being a Roman Catholic, he was cut off from political life and from preferment at court.

Pope's poems are remarkable for the brilliancy and polish of the versification. He excelled in the art of clothing epigrammatic and antithetical expressions in couplets finished with the utmost delicacy of language, but he was wanting in originality and force, and in these respects was inferior to Dryden, whom he resembles in some particulars.

His chief poetical works are:—*A Translation of Homer* (rather a paraphrase than a translation); *An Essay on Criticism*, containing his views on poetical composition; *Rape of the Lock*, a graceful poem dealing with the manners of the time of Queen Anne; *Windsor Forest; The Temple of Fame; An Essay on Man*, a philosophical poem; the *Dunciad*, a powerful satire on the bad poets and other scribblers of his time; and poetical *Essays and Satires*, mostly written in imitation of those of Horace, but dealing with the persons and events of his own day.

Pope's *Literary Correspondence* was also published during his lifetime. His letters abound in wit and keen observations on life and manners, but, being evidently composed with a view to literary effect, they are deficient in epistolary ease and familiarity.

George Berkeley (1684–1753), commonly called Bishop Berkeley, was Bishop of Cloyne in the eighteenth century. He is famous as the author of a philosophical work entitled a *Treatise Concerning the Principles of Human Knowledge*, in which he endeavoured to overcome the materialism of the age by proving the non-existence of matter altogether, and referring

everything which appears to exist to a system of ideas. The book is a marvel of ingenious reasoning, and its logic is said to have remained unrefuted to this day. He also wrote a defence of his system under the title of *A Dialogue between Hylas and Philonous*, as well as several other works in theology and philosophy.

Samuel Pepys (1633–1703) lived in the reigns of the later Stuarts and William III. He wrote a *Diary* for nine years, between 1660 and 1669, in which the records of the court and the town are depicted in lively colours, presenting a picture of the age most valuable to the historian and entertaining to ordinary readers.

Jonathan Swift (1667–1745) was born in Dublin, but his parents were of English birth. He was brought up by relatives, and educated at Kilkenny School and Trinity College, Dublin. Through the influence of his mother he was admitted into the family of Sir William Temple, with whom he lived for some years. In 1694 he took orders in Ireland, where he obtained a small living, but soon afterwards returned to Temple, with whom he lived till the death of the latter, in 1698. He then returned to Ireland, and in 1713 became Dean of St. Patrick's. He now mixed himself up with politics and wrote pamphlets for the Tory party. He continued his political and literary labours till near the end of his life, when he became insane. After three years passed in a state of madness, he died in 1745.

The style of Dean Swift is marked by extreme clearness, purity, and correctness, accompanied by an almost entire absence of ornament. He is the greatest of all English satirists. His chief works are: *Gulliver's Travels*, a bitter satire on mankind, in the form of an account of the wonderful adventures of an imaginary traveller who meets with dwarfs, giants, and other marvellous beings; the *Tale of a Tub*, another satire, on the differences between the Roman Catholics, the Episcopalians, and the Dissenters; *Drapier Letters*, a political work, issued anonymously, attacking Walpole's proposal to introduce into Ireland a copper coinage produced by an English patentee;

and *The Conduct of the Allies*. He wrote numerous essays, articles to newspapers, small poems, and miscellaneous writings.

Thomas Parnell (1679–1718) wrote various poems which were once popular, but are now forgotten, with the exception of *The Hermit*, composed in heroic couplets and distinguished by smooth versification and pleasing description.

William Congreve (1672?–1729) was the most famous of a group of dramatists who flourished in the seventeenth and the early part of the eighteenth centuries, and are termed by Lord Macaulay the "Comic Dramatists of the Restoration." Their writings are characterized by overflowing wit, animated dialogue, and the licentiousness which disgraced the age in which they lived. Congreve was the author of the *Double Dealer*, *Love for Love*, *The Way of the World*, and other comedies, as well as the *Mourning Bride*, a tragedy: **William Wycherley** (1640–1715), of the *Country Wife*, the *Plain Dealer*, etc.: **Sir John Vanbrugh** (1666–1726), of *The Relapse*, *The Provoked Wife*, *The Country House*, etc.: and **George Farquhar** (1678–1707), of *The Recruiting Officer*, *The Beaux Stratagem*, etc.

Edward Young (1684–1765) is famous as the author of the *Night Thoughts*, a long religious poem in blank verse. It is written in a grave and solemn tone, and contains many passages of great beauty, which are frequently quoted. Happy images and allusions are often found, but the metaphors are sometimes overstrained and the style is frequently harsh and obscure. He wrote several other poems, and a tragedy, *The Revenge*, which is still read and occasionally acted.

Joseph Butler (1692–1752) is one of the greatest English theological writers. He was originally brought up to the Presbyterian religion, but joined the Church of England, of which he became one of the brightest ornaments. After taking holy orders, he rose rapidly in the Church, and became Bishop of Durham in 1750.

His *Sermons*, especially three on *Human Nature*, rank high among similar productions. The latter are three very important

essays on moral science. His great work is the *Analogy*, written to point out the agreement or likeness between natural and revealed religion, their mutual connection with and dependence on each other. The reasoning is close and forcible, but the style is dry and harsh, and so concise that the utmost attention is required in order to follow the thread of the argument. Butler's works are more fitted for the theological student than for the general reader.

James Thomson (1700–1748) was a Scotchman by birth, who came up to London to try his fortune as a literary man. Soon after arriving there his poem of *Winter* was published. After a short period of suspense it gained the approbation of the public, and Thomson found himself famous. Poems on Summer, Spring, and Autumn followed; and the four poems appeared together as *The Seasons*. He afterwards composed two other long poems, *The Castle of Indolence*, written in Spenserian stanzas, and considered by many critics as his best work; and *Liberty*, a tedious work which is now almost forgotten. He was also the author of three tragedies, *Sophonisba*, *Agamemnon*, and *Tancred and Sigismunda*. Thomson is chiefly celebrated as a descriptive writer; he had a feeling heart and a warm imagination. His descriptions in the *Seasons* are faithful to nature, and impress the reader with their truth and beauty.

Laurence Sterne (1713–1768), was born in Ireland, though of English descent. He was a clergyman of eccentric and irregular habits. As an author he was one of the greatest masters of humour and pathos who ever lived. His chief work is *Tristram Shandy*, a humorous and eccentric account of his own life. He also wrote the *Sentimental Journey*, another work of the same peculiar kind.

William Shenstone (1714–1763) author of *The Schoolmistress*, and other poems.

Thomas Gray (1716–1771), was born in London. He was educated at Eton, and afterwards at Cambridge, where he excelled as a classical student. Becoming acquainted with Horace Walpole, he accompanied him on a tour to the Con-

tinent. He commenced studying for the legal profession, but not finding it to his taste, and being left in a position of independence by the death of his father, he settled at Cambridge, where he led a life devoted to study and literary composition. He became famous by his poems, and on the death of Cibber was offered the poet-laureatship, which he declined. In 1768 he was made Professor of Modern History at the University. He died in 1771, and was buried beside his mother at Stoke Pogis, near Windsor.

He has written little. His poems are formed on classical models, and are characterized by a refined taste and the exquisite polish of their versification. His chief poems are an *Elegy written in a Country Churchyard; The Progress of Poetry; The Bard;* and an *Ode to Eton College.* The Elegy is perhaps the best known of his works. General Wolfe said of it, the night before his death, that he would rather be the author of that poem than take Quebec.

Sir Horace Walpole, fourth Earl of Orford (1717–1797), has the reputation of being the best English letter-writer. His epistolary correspondence, published after his death, occupies the highest rank among collections of this kind. He was also the author of the *Castle of Otranto,* a romantic story which is still read and admired.

William Collins (1721–1756) is another poet of the same age, whose works are often bound up with those of Gray. He is still highly estimated as a lyrical poet. The best known of his works is the celebrated *Ode on the Passions,* in which the metre and style of the poem are skilfully varied to suit the several parts of the subject. He also wrote an *Ode to Evening,* and several other poems.

Mark Akenside (1721–1770), by profession a physician, was once famous as a poet, but his works are now not much read. His chief work is *The Pleasures of the Imagination,* a poem regular and harmonious in metre, but somewhat strained and artificial in manner.

William Falconer (1730–1769), author of *The Shipwreck*, a descriptive poem.

Sir William Blackstone (1723–1780), born in London, and educated at Charterhouse School and Oxford, followed the profession of the law. He distinguished himself by the authorship of his great work entitled *Commentaries on the Laws of England*. It is now out of date as a legal authority, but it may still be read with pleasure for its clear and graceful style, and for its accurate and lively exposition of the principles which have regulated the growth of laws in general, and of English laws in particular.

Oliver Goldsmith (1728–1774), an Irish writer of great distinction, was born at the village of Pallas, in Longford. His father was a clergyman. He was educated at the village school, and afterwards at Trinity College, Dublin. His irregular habits led to his leaving college for a time, but he was afterwards reinstated through the influence of his brother, and succeeded in gaining his B.A. degree. On finally quitting the college, his unsettled disposition caused him to meet with various misfortunes. Being rejected as a candidate for holy orders, and also failing to succeed in an attempt to become a physician, he travelled through the Continent, supporting himself chiefly by playing the flute. On returning to England he became an usher in a school, then again tried to practise as a physician, and afterwards gained a precarious livelihood by writing for newspapers. After a time his literary productions made him famous, and he became the intimate friend of Dr. Johnson and the other literary men of his time. His extravagant and improvident habits kept him poor, and he died in distress and debt, 1774.

Goldsmith is a miscellaneous writer, of clear and simple but remarkably pleasing style. He wrote both prose and poetry with much success, and still has a large number of readers.

His chief poetical works are :—*The Traveller* and *The Deserted Village*. His powers of satire are shown in *Retaliation*,

a poem in which he shows up the failings and peculiarities of his friends with great good humour, and with abundant wit and sarcasm.

In prose he wrote:—*The Citizen of the World*, containing the satirical observations of a Chinese traveller on the manners and customs of Europe; *The Vicar of Wakefield*, a delightful tale of humble life; a *History of Animated Nature*, a work of very small scientific value, but written in a lively and interesting style; *A History of England*, and other works composed to order for the booksellers.

His two comedies, *The Good-natured Man* and *She Stoops to Conquer*, were acted with great applause during his lifetime, and are still great favourites both with readers and with theatrical audiences.

Samuel Johnson (1709–1784) was the contemporary of Goldsmith, and the literary autocrat of his time. He was born at Lichfield, where he received his early education. Afterwards he went to Pembroke College, Oxford, but was prevented by poverty from remaining long enough to take his degree. For a time he acted as usher in a school at Bosworth, and then worked for booksellers at Birmingham. In 1736 his marriage with a widow, Mrs. Porter, brought him a few hundred pounds, and he set up a school, in which he had Garrick, the famous actor, as a pupil. The school failed, and Johnson and Garrick went together to London. Here be became acquainted with Cave, editor of the *Gentleman's Magazine*, to which he contributed regularly. From this time his reputation as an author gradually increased, though his work was badly remunerated, and he endured years of poverty and misery. At length he became the acknowledged head of English literary men, and his acquaintance was sought after by the most eminent personages of the day. He died in 1784, and was buried in Westminster Abbey.

Johnson's works are much less read than formerly. The style is weighty and vigorous, but wanting in natural grace and flexibility. His periods are high-sounding and frequently in-

flated; he is too fond of high-sounding expressions, and of antithetical arrangements of words and clauses, which become tiresome from their perpetual recurrence. He employs Latin words to the exclusion of those of Saxon origin.

His chief works are:—*London; The Vanity of Human Wishes*, two masterly satires on men and things, written in imitation of two satires of Juvenal; a vast *English Dictionary*, a marvel of patient and on the whole successful work, though very deficient in respect to etymology; *The Rambler*, a collection of periodical essays; *Rasselas, Prince of Abyssinia*, an Eastern tale; *Lives of the Poets;* and *Journey to the Western Islands of Scotland.*

David Hume (1711–1776) was born in Edinburgh, and belonged to an old Scottish family in reduced circumstances. He received an irregular education, partly at the University of Edinburgh. It was intended that he should follow the legal profession; but he soon abandoned the study of the law, and devoted himself to literary pursuits. In 1763 he was made Secretary to the British embassy to France. In that country he became acquainted with the leading French men of letters, and imbibed many of their sentiments and tastes. In 1766 he returned to Scotland, and died in Edinburgh, 1776. His principal works are:—*History of England; Essays, Moral and Political.*

He is regarded as one of the chief English historians; Hume, Robertson, and Gibbon being generally classed together as three of the most prominent writers in historical composition. His style is clear, easy, and attractive.

Dr. Adam Smith (1723–1790), a Scotch writer who is generally regarded as the founder of the science of political economy. He was educated at Glasgow University, where he afterwards filled the chair of Moral Philosophy.

His great work is an *Inquiry into the Nature and Causes of the Wealth of Nations*, in which he expounds his views on trade and industry, reducing them to a regular system. His work is still highly esteemed both for matter and style, though it has

been partially superseded by later writers, who have improved the science of which he so ably laid the foundations. He also wrote :—*Theory of Moral Sentiments*, and a *Dissertation on the Origin of Languages.*

William Robertson (1721–1793), a Scotch historian who is still highly estimated, though his works have to some extent been superseded by the researches of later writers. He was a successful preacher, and for some years held the post of Principal of the University of Edinburgh.

His chief works are :—*History of Scotland* during the reigns of Queen Mary and of James VI. ; *History of the Reign of the Emperor Charles V.*, to which is prefixed a masterly "View of the State of Europe from the Subversion of the Roman Empire to the beginning of the Sixteenth Century"; and a *History of America*, its Discovery and Settlement. His style is marked by elegance, grace, and vigour, which are maintained throughout with an even and continuous flow.

James Beattie (1735–1803), a Scotch poet and philosopher. He is now known chiefly as the author of *The Minstrel*, a beautiful descriptive poem written in Spenserian stanzas. A short poem of his, entitled *The Hermit*, is also still much admired. In prose he wrote :—An *Essay on Truth; Essays on Poetry, Music*, etc. ; a work on *The Evidences of the Christian Religion; The Elements of Moral Science.*

Edward Gibbon (1737–1794), one of the greatest of our historians. He was born at Putney, and, after receiving a private education at home, was sent to Magdalen College, Oxford. He left Oxford through being converted to Roman Catholicism. After a few months' residence in Switzerland, at the house of a Calvinistic minister, he returned to the Protestant faith, but ultimately became a sceptic. During a visit to Rome, he formed the design of his great work while "musing among the ruins of the Capitol, while the bare-footed friars were singing vespers in the temple of Jupiter." A large part of his time was spent at Lausanne, in Switzerland, where he wrote the *Decline and Fall.* He died in London, at the age of fifty-seven years.

Gibbon is famous as the author of *The Decline and Fall of the Roman Empire*, a masterly work, displaying extensive reading, and written in an eloquent and massive though somewhat ponderous style. In some of the earlier chapters he makes an oblique attack upon Christianity with finished irony and sarcasm, weapons which he had entirely at his command. Lord Byron terms him the "lord of irony, that master spell." He also wrote an *Autobiography*, one of the most interesting works of its kind which we possess, and a number of miscellaneous essays.

William Cowper (1731–1800) was born at the parsonage house of Berkhampstead, in Hertfordshire, where his father was the clergyman. He was educated at Westminster School, and at the age of eighteen sent to study the law. He abandoned this career, for which he was unfitted, and settled at Huntingdon in the house of Mr. Unwin. He afterwards lived at Olney, in Buckinghamshire, and at Weston, in Northamptonshire. He was afflicted during the greater part of his life with fits of depression and religious melancholy, which sometimes affected his reason. He died in 1800.

He is one of our best poets. His writings are of a quiet and domestic character, with a decidedly Christian tone. They are still very popular, and show no sign of losing any part of the high reputation which they have long enjoyed.

His chief poem is *The Task*, in six books — undoubtedly one of the finest specimens of blank verse in the English language. The subjects of which it treats are, "The Sofa," "The Time-piece," "The Garden," "The Winter Evening," "The Winter Morning Walk," and "The Winter Walk at Noon." It abounds with beautiful passages in which the pleasures of the domestic circle and of country scenes are described in the most genial and charming language. Cowper's English, as exhibited in this poem, and throughout his works, is a model of purity and refinement. He also wrote : A *Translation of Homer*, a faithful version written in blank verse ; *Table Talk*, *Truth*, *Expostulation*, *Tirocinium*, or a Review of Schools, and many other poems. Some of his smaller pieces, as the *Lines*

Addressed to my Mother's Picture, *John Gilpin*, *The Wreck of the Royal George*, *Boadicea*, are well known and universal favourites. A large number of Cowper's letters have been published. They are regarded as among the best in the English language, being genuine specimens of the epistolary style, easy, familiar, graceful, and expressed in admirable English.

James Boswell (1740–1822), though a man of very inferior abilities, attained to high literary distinction by his admirable *Life of Samuel Johnson*. Boswell was a Scotchman who lived on the most intimate terms with Johnson, for whom his admiration was unbounded. Omitting no opportunity of being in the society of the object of his reverent adoration, he carefully treasured up every word which fell from the great man's lips, and, after the death of the latter, incorporated the materials thus collected in a most minute and interesting account of Johnson's life and conversation. In this manner a more complete and life-like picture has been drawn of Johnson than has ever been composed, by words alone, of any other real personage.

William Paley (1743–1805) was born at Peterborough. He received his first education under his father, who was head master of the grammar school of Giggleswick, in Yorkshire. In 1759 he entered Christ's College, Cambridge. He became senior wrangler, 1763. He was elected fellow and tutor of Christ's College. He entered the Church and obtained a living in Cumberland. In 1782 he was made archdeacon of Carlisle. He became known by his work on Moral and Political Philosophy. In 1790 he published his *Horæ Paulinæ*, a work in which he points out a number of undesigned coincidences between the Acts of the Apostles and the Epistles, and thence infers the truth of both; and in 1794, his *Evidences of Christianity*. He became a prebend of St. Paul's, then sub-dean of Lincoln and rector of Bishopswearmouth. In 1800 he wrote his *Natural Theology*, one of the most popular of his works, in which he attempts to prove the existence of a God by reference to

marks of design in the works of Creation. He died in 1805, and was buried in Carlisle Cathedral.

His chief writings have been mentioned above. His style is a model of clear, forcible, and elegant English.

Thomas Chatterton (1752–1770), "the marvellous boy who perished in his pride," is now chiefly remembered on account of his melancholy history. He was born at Bristol, where he imbibed an early taste for antiquities. When quite a boy he pretended to have found in the muniment room of the church of St. Mary Redcliffe some old poems and other documents written on parchment by Rowley, a monk of the 15th century. The mouldy appearance of the parchment and the antique style of the poems imposed on many persons, but competent judges pronounced them to be forgeries. They had been composed by Chatterton himself, who exhibited in them a wonderful poetic genius for a boy in his teens. After being exposed in this and other attempts of a similar kind, and having vainly endeavoured to earn a livelihood in London, he fell into great distress, and destroyed himself by taking arsenic.

Among the poems issued under an assumed name were :— *The Tragedy of Ella; The Bristow Tragedy*, or *the Execution of Sir Charles Bawdin; The Battle of Hastings; The Tournament;* and a description of *Canynges Feast.* He also published some poems in his own name, but these are of inferior merit.

Edmund Burke (1730–1797), the "philosophical statesman," was born at Dublin, and educated at Trinity College, in the same city. After studying the law for some time in London, he took to literary pursuits, and wrote an *Essay on the Sublime and Beautiful*, which gained for him a considerable reputation. He became private secretary to the Prime Minister, Lord Rockingham, 1765, and member of Parliament for Wendover, 1766. He soon distinguished himself as the finest orator in the House of Commons. He took a prominent part in all the great questions of the day, opposed the taxation of the American colonies, led the impeachment of Warren Hastings, and de-

nounced the principles of the French Revolution. He died in 1797, leaving an unspotted name, and the reputation of being a pure and lofty patriot, and one of the finest speakers England has ever produced.

His style of oratory was rich and brilliant in the extreme, full of philosophical reasoning, lofty sentiments, and rich and noble imagery. His flights of fancy were often above the tastes of his audience, and he frequently failed to persuade his hearers of the truth of his arguments.

His chief works are :—*Essay on the Sublime and Beautiful*, mentioned above ; *Speeches ; Reflections on the French Revolution*, one of the most famous of his works, and containing passages of almost superhuman eloquence ; *On the Cause of the Present Discontent ; Letters on a Regicide Peace*, etc.

Richard Brinsley Sheridan (1751–1816) was a dramatic writer, statesman, and wit of the reign of George III. He was an adherent of Fox and the Whig party. His famous speech at the trial of Warren Hastings created a profound sensation, and raised his reputation for oratory to the highest point. The later years of his life were passed in distress, and he died in London, abandoned by the society which had once flattered him, and deeply in debt.

His famous comedies, *The Rivals*, and *The School for Scandal*, sparkle with wit, and are still among the most popular pieces acted on the English stage. He also wrote *The Critic*, *The Duenna*, and several other dramas which are less known.

George Crabbe (1754–1832) was a clergyman who published several poems, written in a rugged but powerful style, and containing many passages marked by great powers of descriptive narrative and tender pathos. His longest poem is the *Borough*, in which he describes minutely various localities and persons in a small town. He also wrote *The Village*, *The Parish Register*, *The Library*, *Tales in Verse*, *Tales of the Hall*, and several other poems, all composed in heroic couplets.

Robert Burns (1759–1796), the greatest of Scotch poets, was

born in a small cottage near the town of Ayr, in a neighbourhood rendered famous by his poems. His father was a small farmer, and Robert took to farming himself, but without success. When about to leave his native land to try his fortune in Jamaica, the great success of a small volume of his poems just published induced him to alter his mind, and proceed to Edinburgh. Here he was warmly received by society, and the proceeds of his poems enabled him to start another farm at Ellisland, near Dumfries. He also received a small salary as exciseman, and on this he lived when his farm failed. His sympathies with revolutionary principles prevented him from rising in the public service, and repeated disappointments caused him to fall into dissolute habits. His health broke down, and he died in 1796.

Burns' poems are mostly written in the Scotch dialect, and in a homely phrase which makes them special favourites with the common people. They are characterized by a charming melodiousness of sound, a happy power of terse and vigorous expression, a hearty, fresh, and genial humour, and deep pathos. An enthusiastic love of nature breathes throughout his works. His songs, many of which he set to the old tunes of his native land, are among the finest lyrical pieces in the language. His poems are short but numerous. Some of the best known are : *Tam o' Shanter*, usually considered his best work, a strange and marvellous story of which the scene is laid in the vicinity of his own birthplace ; *Halloween ; The Cotter's Saturday Night ; The Brigs of Ayr ; The Twa Dogs*, a tale ; *The Vision*, a poem relating to himself, and his own poetic inspiration ; *To a Mountain Daisy*, on turning one down with a plough ; *To a Mouse*, on turning her up in her nest with the plough ; *Address to the Toothache ;* and *The Jolly Beggars*. The following are the titles of some of his best songs : *Robert Bruce's Address to his Army*, "Scots wha hae wi' Wallace bled," etc. ; *John Anderson, my Jo ; Lament of Mary Queen of Scots* on the approach of Spring ; *To Mary in Heaven ; Highland Mary ; Mary Morison ; Auld Lang Syne* ; *For a'*

that and a' that; The Birks of Aberfeldy; The Banks o' Doon; Bonnie Bell; Coming thro' the Rye.

James Grahame (1765–1811), author of *The Sabbath*, a religious poem.

Robert Bloomfield (1766–1823), author of *The Farmer's Boy*, and other poems.

Reginald Heber (1783–1826), author of *Palestine*, a poem.

William Wordsworth (1770–1850), the greatest English poet of the present century, was born at Cockermouth, Cumberland. From his earliest years he was associated with the Lake District, whose beautiful scenery he was destined to illuminate with the radiant light of poetic genius. He was sent to school at Hawkshead, near Lake Windermere. In 1783 his father died, and left him in somewhat straitened circumstances. From Hawkshead he went to St. John's College, Cambridge. During one or two visits to France, he imbibed something of a revolutionary spirit, sympathising with what he regarded as the awakening of that country from a long subjection to despotism; but these pleasant dreams were afterwards dispelled by the fearful atrocities which followed the outburst of the French Revolution. In 1793, Wordsworth published his first poems. They were of a simple kind, and did not suit the taste of the public, trained in the artificial school of Pope and his imitators. Coming to reside in the south of England, he became acquainted with Coleridge, who from the first was an ardent admirer of Wordsworth's poetry. After a tour in Germany, Wordsworth settled at Grasmere, and continued to reside in the Lake District till his death. He published various poems from time to time, but had long to wait before his merits as a poet were acknowledged. His writings were fiercely attacked by Lord Jeffrey in the *Edinburgh Review*, but they were ever attracting a larger circle of disciples, and at length he was hailed as the most original and gifted of living English poets. He died in 1850, and was buried in the churchyard of Grasmere.

His poems are very numerous, among them may be mentioned: *The Excursion*, a long poem in blank verse; *The*

Prelude; The White Doe of Rylstone; Peter Bell; The Wagoner; many *Sonnets*, reckoned among the best in the English language: *Yarrow Unvisited, Yarrow Visited*, and *Yarrow Revisited; Lines on the Wye; The Brothers; Ode on Immortality*, and *Ode to Duty*. Some of his small simple poems are well known; as, *Lucy Gray; We are Seven; The Pet Lamb*, etc.

Wordsworth's style is natural and simple, at times rising into the utmost beauty and majesty when his subject gave him scope for the exercise of his highest powers. His writings are characterized by a passionate admiration of nature, and an ardent love of liberty. He is perhaps our greatest philosophic poet. His entire philosophy is based on the study and love of nature, regarded as a great moral teacher, in connection with the broad truths of Christianity. No poet has furnished us with a higher and nobler scheme of practical philosophy, enforced by reflections drawn from the inspired volume and from the contemplation of nature in her various moods and forms.

Sydney Smith (1771–1845), an English clergyman, wit, and essayist, is now remembered chiefly from his connection with the *Edinburgh Review*, of which he was one of the founders. To this periodical he contributed many essays and reviews, all marked with pungent wit and sparkling satire. Smith was a firm advocate of civil and religious liberty, and most of the acts which relieved the subject from disabilities connected with forms of religion and position in society were passed with the help of his support. His essays and reviews have been issued in a collected form. Next to these, his *Peter Plymley's Letters*, a characteristic production, supporting Roman Catholic emancipation, is the best known of his works.

James Montgomery (1771–1854) is the author of several pleasing poems of a simple character, written in a quiet but agreeable and harmonious style. He published three lengthy poems: *The World Before the Flood; Greenland;* and *The Pelican Island.* Some of his short poems, and passages from his longer ones, are familiar to most readers.

Charles Lamb (1775–1834). This delightful author was born

in London, and educated at Christ's Hospital. At this celebrated school, which he often mentions in his writings, he formed the acquaintance of the famous poet, Coleridge, who was one of his schoolfellows. After leaving school he became a clerk in the East India House, 1792. Here he continued to serve until 1825, when he retired with a pension. His only sister was subject to fits of insanity; in one of these she killed her own mother. She was, however, allowed to be at liberty, and Charles took charge of her for the remainder of her life with the most affectionate care. He wrote several poems, and one or two dramas, which are not much read. His essays are among the most delightful in the English language. The *Essays of Elia*, in particular, are full of the most delicate humour, and charm every reader by their peculiar style, in which the character of the author is strongly reflected. Together with his sister, he wrote *Tales from Shakespere*.

James Hogg (1772–1835), known as the "Ettrick Shepherd,' was born near the banks of the Ettrick, a tributary of the Tweed. Most of his life was spent in farming, and in writing poetry, which made him famous. He wrote many books, some of which are little known. His best poem is the *Queen's Wake*, a collection of pieces supposed to be sung by the minstrels who had assembled at Holyrood Palace in Edinburgh, to take part in the festivities in honour of the return of Queen Mary to Scotland.

Samuel Rogers (1763–1855), a poet who lived to a great age, was the author of several poems written in a pleasing and graceful style, formed on classical models. His chief works are:—*The Pleasures of Memory*, written in heroic couplets; and *Italy*, a long descriptive poem in blank verse. Some of his shorter poems, as *Human Life*, *A Wish*, etc., are much admired.

Thomas Campbell (1777–1844), a popular Scotch poet, whose works are remarkable for their melodious ring and earnest impassioned tone. His chief works are: *The Pleasures of Hope*, composed in heroic couplets; and *Gertrude of Wyoming*, in

Spenserian stanzas. He is now perhaps best known by some of his small pieces, which are extremely popular; as, *Hohenlinden; Ye Mariners of England;* and *Lochiel's Warning.*

Sir Walter Scott (1771–1832) is perhaps the greatest writer Scotland has ever produced. His reputation is high both in prose and in poetry. He was born in Edinburgh, and educated at the High School, and afterwards at the University of that city. From a very early age he exhibited an ardent taste for reading, a remarkable love for the old legends of his native land, and a wonderful power of inventing and relating stories of his own. His natural tendencies were greatly encouraged and developed by reading Percy's Reliques of Ancient Poetry. Scott studied for the law, and became an advocate in 1792. After a time he virtually abandoned this profession for literature. He published translations from German poets, and in 1802 appeared his *Minstrelsy of the Scottish Border*, a number of ballads collected by himself from the country people of the district, and enriched with copious notes showing great knowledge of Scottish and English antiquities. In 1805 his poem *The Lay of the Last Minstrel* made him famous. From that time works flowed plentifully from his pen. As a poet he was after a time eclipsed by Byron. He then turned his attention more particularly to prose, and produced the *Waverley Novels*, perhaps the most famous series of prose fictions in the English language. In these his characteristics as a writer are shown to great advantage; his knowledge of antiquities; his great power of describing persons, things, and events; and his vast genius for creating and delineating characters, in which he has been surpassed by Shakspere alone. Scott's writings brought him great profits, and he built a large house, Abbotsford, on the banks of the Tweed, where he resided till his death. Through speculative trade undertakings in connection with a publishing firm, he became involved in pecuniary difficulties to a vast amount. The latter part of his life was devoted to clearing off his debts by the most gigantic literary efforts. His works sold for immense sums, and ultimately all his creditors were paid to

the last farthing. His end was hastened by over-work. After a short visit to Italy, with a view to recruiting his health, he came home to die on the banks of his beloved river. "It was a beautiful day (says his son-in-law and biographer)—so warm that every window was wide open—and so perfectly still that the sound of all others most delicious to his ear, the gentle ripple of the Tweed over its pebbles, was distinctly audible as we knelt around the bed, and his eldest son kissed and closed his eyes," 21st September, 1832.

His principal poems were stories founded on old legends of Scotland and the north of England. They were written chiefly in rhymed couplets of four iambic feet to each line, and are chiefly remarkable for the easy flow of the verse, and fine and vivid descriptions of events and of Scottish scenery. The most famous are: *The Lay of the Last Minstrel; Marmion; The Lady of the Lake; Rokeby;* and *The Lord of the Isles.* Other poems are: *The Field of Waterloo; The Bridal of Triermain; The Vision of Don Roderick;* and *Harold the Dauntless.*

In prose Scott acquired his chief fame as the author of the *Waverley Novels*, mentioned above, of which the first were published anonymously. Some of the best are: *Waverley; Rob Roy; Guy Mannering; The Antiquary; Old Mortality; The Heart of Midlothian; Ivanhoe; Kenilworth;* and *Quentin Durward.* Most of his novels deal with historical persons and events, which are interwoven with the thread of the story with wonderful art and skill. Scott also wrote: *Life of Napoleon; Tales of a Grandfather*, in which the History of Scotland is related in a simple and interesting style; a *History of Scotland*, and many other works. He wrote the life, and edited the works, of Dryden.

Samuel Taylor Coleridge (1772–1834), a poet of the present century, was educated at Christ's Hospital, and at Jesus College, Cambridge. Owing to a disappointment in love affairs, he left college and enlisted as a private soldier in the army. Having been released from this engagement by friends, he took up his residence in Bristol. He became acquainted with Southey

and Wordsworth, and a prominent member of the rising poetical school. A visit to Germany gave him an intense admiration for German literature, and greatly influenced his ideas and opinions, as well as his literary style. The latter years of his life were spent in London. Most of his time was devoted to literature, but he was of an indolent nature, and incapable of sustained efforts. His conversational powers were highly estimated by a circle of intimate friends, who listened with rapture to the intellectual and mystical talk of the poet. He died at Highgate.

Coleridge's style is of an original kind, irregular, mystical, and dreamy. The thoughts are often confused, and expressed in a half-foreign idiom, but many passages of great beauty are to be found in his works. With industry and perseverance Coleridge would probably have produced some really good work. His chief poems are: *The Ancient Mariner*, a solemn and mysterious tale of the sea; *Christabel*, remarkable for the music of the verse; *Ode to France; Ode to the Departing Year* (1795); *Hymn before Sunrise in the Vale of Chamouni*; and *Remorse*, a tragedy. He also translated Schiller's Wallenstein, and other German works.

His prose works were mostly pieces contributed to various papers and magazines, and lectures delivered by himself and afterwards published. Of these his lectures on Shakspeare are perhaps best known.

Robert Southey (1774–1843) was a miscellaneous writer contemporary with Wordsworth and Coleridge, and belonged, like them, to the "Lake School" of poetry. He was the son of a linen-draper at Bristol, where he was born. He was educated at Westminster School, and at Balliol College, Oxford. His friends intended him to become a clergyman, but he soon abandoned theological pursuits, as well as the study of the law, which he had afterwards taken up. One or two early successes induced him to devote himself to literature, in which he met with great success. In 1804 he settled at Keswick, in Cumberland, where he passed the rest of his life. In 1813 he was made Poet Laureate.

Southey's poetry was once popular, but is now nearly forgotten. His pieces are long, somewhat artificial, and wanting in human interest, though they contain fine descriptive passages. His chief poems are: *Joan of Arc; Thalaba the Destroyer; The Curse of Kehama;* and *Roderick, the Last of the Goths. How the Water comes down at Lodore* and a few other of his shorter poems are well known.

His prose style is simple, easy, unaffected, and graceful. Some of his biographies are still read. The *Life of Nelson* is very popular, and the lives of *Cowper*, *Bunyan*, and *Wesley* have many readers. Southey also wrote a *History of the Peninsular War* and a *History of Brazil*.

George Gordon, Lord Byron (1788–1824), one of the most famous poets of the reign of George III., was born in London, but much of his early youth was passed at Newstead Abbey, the ancient seat of the Byron family. He was educated at Harrow School, and then at Trinity College, Cambridge. While at Cambridge he published his first volume of poetry, *Hours of Idleness*. It was fiercely attacked by Lord Jeffrey in the *Edinburgh Review*, and Byron retaliated by his vigorous satirical poem *English Bards and Scotch Reviewers*, a work which established Byron's reputation as a poet. Byron's early home training was defective, and his future life dissolute and unhappy. He married the daughter of Sir Ralph Milbanke, but the union proved unhappy, and a separation took place at the end of one year of marriage. He was driven from England by an outburst of social indignation, which probably proceeded from anything but pure zeal for virtue, and passed the rest of his life on the Continent. After some years spent in Switzerland and Italy, he, in 1823, identified himself with the cause of Greek Independence, attaining great influence and a high position among the leaders of that movement. While engaged in this work he was overtaken by fever, and died at Missolonghi in 1824. He was buried in the family vault at Hucknall Church, near Newstead.

Lord Byron's poetical style is grand and magnificent. His

poems abound in splendid descriptions of natural scenery and objects of art. The majestic roll of his verse has never been surpassed for grandeur, but in some passages there is a tendency to degenerate into bombast. The thought is often overloaded with ornament. Byron's love of nature, and particularly of the sea, appears throughout his works, and he did much to popularize the ideas of Wordsworth, by expressing them in more striking and attractive language. His chief poems are:—*Childe Harold*, a magnificent poem written in Spenserian stanzas, and describing the countries of the south of Europe; *Don Juan*, in some respects his finest work, but defaced by immorality; *The Prisoner of Chillon; The Giaour; The Bride of Abydos; The Siege of Corinth; Lara; Mazeppa; English Bards and Scotch Reviewers.*

Byron wrote several dramas. They contain splendid passages, but are not successful as representations of human life and character. Byron could describe only one individual: a dark, gloomy, brooding, mysterious, passion-haunted being, in many respects the counterpart of himself. Such is his Childe Harold, his Manfred, his Cain, and his other heroes. His principal dramas are: *Manfred; Cain; Sardanapalus; Werner; The Two Foscari; The Deformed Transformed; Marino Faliero.*

Thomas Moore (1779–1852), an Irish poet, biographer, and essayist. His poems are remarkable for their simple but effective melody, and a happy power of expression. He wrote *Irish Melodies*, a famous collection of Irish songs, all of which have been set to music, and many of which are extremely popular; *Lalla Rookh*, a collection of Eastern tales, characterized by harmonious numbers and gorgeous imagery; and various short poems of a descriptive and satirical kind. His chief prose work is a *Life of Lord Byron.*

Percy Bysshe Shelley (1792–1822) is now recognised as one of the greatest poets of the present century. He belonged to a family of good standing in the county of Sussex, and was educated at Eton. Shelley afterwards went to Oxford, but his

peculiar opinions with regard to religion caused him to be expelled from the university. Endowed with great powers of intellect and tender sensibility of nature, frowned at by his friends, and rejected by society, his future life was an unhappy one. The last years of his life were passed in Italy, and he was drowned with two companions in a sailing boat off Leghorn.

Shelley's poems are famous for the beautiful and varied music of the verse, as well as for the grandeur of the thoughts. His chief works are :—*Queen Mab*, a strange poem in which his sentiments with regard to nature and the Deity find expression in wild and terrible language ; *Alastor*, or the Spirit of Solitude ; *The Revolt of Islam; The Cenci*, considered by some eminent critics to be the finest tragedy of the present century ; and *Prometheus Unbound*. Some of his shorter poems and odes are better known than his larger works, and exhibit his powers of harmonious versification to great advantage.

Henry Hallam (1777–1859) was educated at Eton and Oxford. He first became distinguished by his writings in the *Edinburgh Review* and other leading periodicals. He then turned his attention to history, and produced a series of works marked by great learning, deep philosophical views, a remarkable power of investigation, and an unswerving regard for the truth. His principal works are :—*View of the State of Europe during the Middle Ages; The Constitutional History of England* from the accession of Henry VII. to the death of George II. ; and *Introduction to the Literature of Europe* in the 15th, 16th, and 17th centuries.

Thomas de Quincey (1786–1859) was the son of a Manchester merchant, who dedicated most of his life to literature. His style is clear, forcible, and imaginative; his works display a great command over the resources of the English language, and a rich fund of humour of a peculiar kind. His chief work is *Confessions of an Opium Eater*, in which a portion of his own life and experiences is related. He also wrote the *Logic of*

Political Economy, and a great number of miscellaneous essays, which have been published in a connected form.

Felicia Dorothea Hemans (1794–1835), commonly known as Mrs. Hemans, is one of our best female poets. Most of her life, from the years of childhood, was devoted to literature. She published several volumes of poetry, including the *Vespers of Palermo*, a tragedy; *The Forest Sanctuary;* and *Tales and Historic Scenes*. Her longer poems are not now much read, but some of her shorter pieces, as *The Homes of England*, *The Graves of a Household*, *The Treasures of the Deep*, enjoy an immense popularity. Her works exhibit a great command of poetical language and imagery, but the thoughts are superficial, and there is a lack of imaginative power.

Joanna Baillie (1762–1851), a Scotch poetess of great merit, has won a great reputation as the authoress of several dramas, entitled *Plays on the Passions*. They are remarkable, not for any power of drawing human characters of a natural and life-like kind, but for depicting the action of the passions in their intense and profound workings. Amid much that is artificial and uninteresting there are passages of splendid poetry, and skilful analyses of single passions scattered through these plays.

John Keats (1796–1821), one of the best poets of the present century. He was apprenticed to a surgeon, but devoted all his spare moments to literary pursuits. His health was naturally delicate, and his end is said to have been hastened by grief at the rough treatment his poems received at the hands of the *Quarterly Review* and other critical periodicals. He died at Rome, and was buried near Shelley, in the Protestant cemetery. His early death was a great loss to English literature.

His poems are characterized by rich powers of imagination, though not always chastened by ripe judgment. Some of his single lines and stanzas are, however, exquisitely finished. Keats's chief poems are: *Endymion*, a poetic romance in blank verse; *The Eve of St. Agnes*, a highly wrought poetic gem

written in Spenserian stanzas; *Lamia; Isabella*, and several small odes and miscellaneous poems.

Thomas Hood (1798–1845) occupies a high place as a humorist, and also as a writer of serious poems. He was specially clever at the manufacture of puns, a low form of wit which in his hands acquired considerable dignity, and met not only with toleration but admiration. His chief writings were issued in the form of serial publications issued under the names of *Whims and Oddities; The Comic Almanac; Hood's Own;* and *Hood's Magazine.* His great abilities as a poet are perhaps best shown in his serious poems; as *Eugene Aram; Song of a Shirt; The Bridge of Sighs;* and *The Plea of the Midsummer Fairies. Miss Kilmansegg and Her Precious Leg* is a wonderful combination of wit, humour, pathos, and satire. In prose Hood wrote: *Tylney Hall*, a novel; *Up the Rhine*, a series of humorous descriptive sketches; and many pieces of a miscellaneous kind.

Walter Savage Landor (1775–1864), author of *Imaginary Conversations*, a series of prose dialogues.

Thomas Babington (Lord) Macaulay (1800–1859), one of the chief literary men of this century, was born in Leicestershire, and educated at Trinity College, Cambridge. At the university he distinguished himself by twice gaining the Chancellor's medal for poems on *Pompeii* and *Evening*, and also by his classical scholarship and debating powers. He was elected Fellow of Trinity, and thenceforth devoted his attention to literature. In 1825 he became famous by his splendid essay on *Milton*, contributed to the *Edinburgh Review.* From this time his contributions were the chief attraction of that celebrated periodical, and were regularly looked for by the literary public with eager expectation. Macaulay was a member of the Whig party, which found in him a valuable supporter. He entered Parliament in 1830, as member for Calne, and was one of the most earnest and eloquent speakers in favour of the Reform Bill of 1832. He sat in the reformed Parliament as member for Leeds, and in 1833 went out to India as a member of the

Supreme Council. On his return to England he held office (as member for Edinburgh) under the Whig Government, and assisted his party in carrying the Roman Catholic Relief Bill and other liberal measures. Edinburgh, in a fit of resentment, rejected him at the election of 1847, but made reparation for its caprice by re-electing him in 1852. Macaulay was one of the most effective speakers in Parliament. Whenever he spoke, the House was crowded to overflowing, and his splendid periods were listened to with breathless attention. In 1857 he was raised to the peerage. He died at Kensington, 1859, and was buried in Westminster Abbey.

Macaulay's prose style is peculiarly his own. His sentences are short, epigrammatic, and forcible. His descriptions of men, places, things, and events are graphic, and clothed in superb and stately language. He has the art of writing that which people like to read. His chief work is a *History of England from the Accession of James II.*, which he left unfinished. No one can help admiring the splendour of style nor the absorbing interest of the narrative; but Macaulay has been accused of falsifying the truth of history for party purposes. This charge has, however, never been satisfactorily proved. It would perhaps be more correct to say that he sometimes abandons strict historical accuracy in order to give point to an antithesis, or heighten the effect of his narrative. His *Essays* collected from the *Edinburgh Review* and other publications are chiefly on historical, critical, and biographical subjects. His *Speeches* have also been reprinted, and much resemble his Essays in style and subjects.

Macaulay also wrote poetry, which possesses the same characteristics as his prose. His *Lays of Ancient Rome* exhibit vivid pictures of the life of the ancient Romans, and are written in spirit-stirring language which awakens the deep interest of the dullest reader or hearer. The lay entitled *Horatius* is a special favourite; it would be difficult to imagine anything more perfect of its kind. His short and vigorous poems *Ivry* and *The Armada* are well known.

George Grote (1794–1871), a famous historian, is known chiefly by his *History of Greece*, in which he exhibits great learning, and a remarkable ability for investigating the truth amid the imperfect and conflicting records of ancient times. He also devoted his attention to Greek philosophy, and published works on *Plato* and *Socrates*. His *History of Greece* is the standard work on the subject.

John Stuart Mill (1806–1873), a celebrated writer on Political Economy, was the son of James Mill, an author who acquired considerable fame by his *History of British India*. His life was devoted to literature, and, in a less degree, to politics. For a few years he was member of Parliament for Westminster, being returned in the interests of the Radical party.

He is a writer remarkable for great powers of thought, which he expresses in clear, forcible, and logical English. A long residence in France had given somewhat of a French tone to his ideas, and to his manner of expressing them. His chief works are: the *Principles of Political Economy*; a masterly essay on *Liberty*; a *System of Logic*; an *Examination of Sir William Hamilton's Philosophy*; and a great number of miscellaneous essays.

Thomas Carlyle (1795–1881), a miscellaneous writer of great reputation, was born in an obscure village in Dumfries. He was educated at the country schools in his neighbourhood, and afterwards passed some years at the University of Edinburgh. After declining to follow his father's wishes by entering the Church, and failing to obtain a livelihood in the teaching profession, which he found uncongenial to his tastes, he commenced his career as an author at Edinburgh. At first he wrote essays and translations from German and other authors, with only limited success. His original works were also slow in attracting public notice, and even *Sartor Resartus*, considered by some admirers to be his best work, failed for some time even to find a publisher. He lived for some time in retirement with his wife at a farmhouse in Dumfries, studying and writing with

the greatest assiduity. In 1833 he removed to London, and took up his abode in Cheyne Row, Chelsea, where he resided during the rest of his life. The merit of Carlyle's work gradually became known to English readers, who at length looked upon him as the chief man of letters in England. He died at a great age, and was buried near his mother in the churchyard of Ecclefechan, the parish in which he was born.

Carlyle's style is peculiar. It is formed partly on that of the chief German writers, whom Carlyle ardently admired and diligently studied, and abounds in original compounds and quaint but forcible turns of expression. Many readers are repelled, especially at first, by the rugged peculiarities of style, while others feel the most passionate admiration for it. His works, though irregular in style, are characterized by intense earnestness of tone, and contain passages of the keenest satire mixed with the richest humour and profound wisdom. Carlyle's chief works are the following:—

Sartor Resartus, a sarcastic and humorous work on the philosophy of clothes; *History of the French Revolution*, a series of vivid historical pictures; *Past and Present*, a sketch of English life in the Middle Ages; *Cromwell's Letters and Speeches*, one of his best works; *History of Frederick the Great; Lectures on Heroes;* a *Translation of Goethe's Wilhelm Meister's Apprenticeship; Life of Schiller; Life of Sterling;* and *Miscellaneous Essays.*

Alfred Tennyson, born 1810, the present poet-laureate. He is the son of a Lincolnshire rector, and was educated at Trinity College, Cambridge, where he gained the Chancellor's medal by a prize poem entitled *Timbuctoo*. His life has been quiet and retired, devoted to study and literature. He resides in his country seat in the Isle of Wight.

Tennyson's poems are remarkable for a chaste, elegant, and musical style. He has an extraordinary command over words, which he uses in the most happy manner to express his precise meaning in clear, picturesque, and polished language. Tennyson's chief poems are the following:—

The Princess, a poetical romance; *Idylls of the King*, a series of beautiful romantic tales written in blank verse, and dealing with the legends concerning the ancient British king Arthur and his knights of the Round Table; *In Memoriam*, an elegiac poem (the finest of the kind in the language) written in memory of his friend Arthur Hallam, son of the historian; *Maud; Enoch Arden*, a touching story of humble life. He has also written many short lyrical pieces, all displaying his harmonious and graceful style and his happy power of employing words. Some of the best of these are: *Ode on the Death of the Duke of Wellington; Welcome to the Princess Alexandra; The Charge of the Light Brigade at Balaclava; Tithonus; Lucretius; The Lotos-eaters.*

Mr. Tennyson has written several dramas, but they have not met with much success. *Queen Mary* and *Harold* contain many spirited lines, but they are deficient in dramatic qualities. Several shorter dramatic pieces written for the stage have not met with public approval. The latest of these, *The Promise of May*, was almost hissed off the stage on its first appearance.

Elizabeth Barrett Browning (1809–1861), one of our greatest female poets. She was a woman of high culture and great poetical gifts. In 1833 she translated the *Prometheus* of Aeschylus. This was followed by a succession of poems, all characterized by depth of feeling, and a great command over poetical language. In 1846 she married the famous poet, Robert Browning (see next article).

Her chief poems are: *The Seraphim; Lady Geraldine's Courtship; Casa Guidi Windows*, an Italian tale; *Aurora Leigh*, her longest poem; and *Tales before Congress.*

Robert Browning, one of our greatest living poets, was born in London, 1812. His life has been devoted to literature. He has numerous admirers, but his poems are not so much read as those of Tennyson. Mr. Browning is a deep thinker, but his mode of expressing himself is often obscure, and taxes the intelligence of the reader to a high degree. His chief poems are: *Paracelsus; Strafford* (both dramatic pieces); *Sordello;*

Pippa Passes; Men and Women; The Ring and the Book, a long poem founded on events happening in Italy; *Balaustion's Adventure; Red Cotton Night-cap Country; Aristophanes' Apology; The Inn Album;* a *Translation of the Agamemnon* of Aeschylus; and *Jocoseria.*

NOVELISTS.

One of the most remarkable features in modern literature, both in England and other civilized countries, is the novel. There is nothing exactly like it in Greek or Roman literature, though such works as the *Metamorphoseon*, commonly called The Golden Ass, of Apuleius are somewhat similar in construction and scope. In England this species of composition has been developed to an extraordinary degree. Many of our best writers have devoted their talents to it, and have produced works large in size, elaborate in structure, and dealing with human life in all its various forms. Not only fictitious matter is presented, but history also is pressed into the service of these writers; and real personages, eminent in politics, literature, or the arts, as well as remarkable events of bygone times, are introduced whenever it may appear desirable. Hence we have historical novels, based on history, as well as purely fictitious novels. Very frequently historical scenes and personages undergo considerable change when transferred to the pages of the novelist, who considers that, as he is writing a fictitious work, and not a true history, he has a right to mould characters and events according to his will, whenever he can thereby heighten the effect of his narrative. It is therefore necessary to read such works with caution, lest an erroneous impression of historical persons and events may be permanently retained. In this short chapter it would evidently be impossible to give a detailed account of all the eminent authors who have dedicated their powers to this branch of English literature. We must limit ourselves to naming a few of the principal novelists, and giving a list of their principal works.

Samuel Richardson (1689–1761) is generally regarded as the father of English novelists. His works are of great length, and are pervaded by a highly moral and even religious tone. They were once very popular, but are now nearly forgotten. His chief works are: *Pamela; Clarissa Harlowe;* and *Sir Charles Grandison.*

Henry Fielding (1707–1754) wrote in a much more vivacious and entertaining style than Richardson. His novels are very skilfully constructed, and present well-drawn pictures of human life, but they are defaced by immoral scenes. He wrote *Tom Jones,* one of the best-constructed fictions in the English language; *Amelia;* and the *History of Joseph Andrews.*

Tobias Smollett (1721–1771) was a Scotch novelist. His works are lively in tone, and remarkable for broad humour and skilful delineation of character. His chief works are: *Adventures of Roderick Random; Adventures of Peregrine Pickle;* and *The Expedition of Humphrey Clinker.*

Laurence Sterne (see above, p. 269) wrote *The Life and Opinions of Tristram Shandy,* which can scarcely be called a novel.

Oliver Goldsmith (see above, p. 271) wrote *The Vicar of Wakefield,* one of the most pleasing tales in the English language.

Madame D'Arblay (1752–1840), better known by her maiden name, **Frances Burney,** was the authoress of *Evelina, Cecilia,* and *Camilla,* remarkable for their clever and true pictures of life.

William Godwin (1756–1836) wrote *Caleb Williams,* an interesting narrative, still popular.

Miss Maria Edgeworth (1767–1849), one of our chief female novelists, wrote works descriptive of the scenery and people of Ireland, her native country. Her chief works are: *Castle Rackrent; Moral Tales; Popular Tales; Tales of Fashionable Life; Patronage.* Her novels are characterized by a great

power of delineating character, and are pervaded by a high moral tone.

Miss Jane Austen (1775–1817) is an admirable writer, whose works rank among the best fictions in the English language. Her characters are cleverly drawn, and discriminated with minute and delicate touches. She wrote *Pride and Prejudice; Mansfield Park; Emma*, and other works.

Sir Walter Scott is one of our greatest novelists (see page 283).

Captain Marryatt (1792–1848) wrote *Peter Simple; Midshipman Easy; Jacob Faithful*, and other lifelike and entertaining tales, mostly relating to sea affairs.

Lord Lytton (1805–1873) was a prolific novelist, who wrote in a lofty style, sometimes degenerating into bombast. His novels are very popular. Among the best are: *Pelham; The Last of the Barons; Harold; The Last Days of Pompeii; The Caxtons;* and *My Novel.*

Benjamin Disraeli, Earl of Beaconsfield (1805–1881), once Prime Minister of England, was the author of several popular novels, in some of which real political characters are introduced under feigned names. Among his works are: *Sybil*, or the Two Nations; *Vivian Grey; Coningsby; Lothair;* and *Endymion.*

Charles Dickens (1812–1870) was the author of some of the most delightful fictions ever produced. His characters, mostly taken from humble life, are delineated with such minute and happy touches, with such a peculiar charm of language, and in such a rich vein of peculiar and delicious humour, that they seem to exist as real living beings known to all the readers of Dickens' works, that is, to nearly all the British and American public. His novels have been translated into most civilized languages, and are immense favourites wherever they are known. His chief fictions are: *Pickwick Papers*, the work which first brought him into general notice, and which introduced the immortal Sam Weller to the world; *Nicholas Nickle-*

by; Oliver Twist; Martin Chuzzlewit; Old Curiosity Shop; Barnaby Rudge; Bleak House; Little Dorrit; Our Mutual Friend.

William Makepeace Thackeray (1811–1863) was a pungent satirist, a keen observer of manners and character, and a master of forcible and elegant English. His chief works of fiction are: *Pendennis; The Newcomes; Vanity Fair; The Virginians;* and *Esmond.*

Charlotte Brontë (1816–1855) was a female novelist who possessed great perception of character, and a remarkably elegant and vigorous style. She wrote *Jane Eyre; Shirley;* and *Villette.*

Her sisters **Emily** and **Anne Brontë** wrote respectively, *Wuthering Heights* and *Agnes Gray.*

Mrs. Lewes (1820–1880), generally known by the literary pseudonym **George Eliot,** was one of the greatest writers of fiction of the present century. Her maiden name was Mary Ann Evans. She was a woman endowed with splendid intellectual gifts, which she improved by assiduous reading and study. Most of her works portrayed, with wonderful skill, the ordinary English life of the Midland counties. Her chief works are: *Adam Bede,* the work which first made her famous; *The Mill on the Floss; Silas Marner; Romola,* an historical tale of which the scene is laid in Florence in the times of the Middle Ages; *Felix Holt,* the Radical; *Middlemarch; Daniel Deronda,* a Jewish story; *The Opinions of Theophrastus Such;* and *Scenes of Clerical Life.*

Other novelists recently deceased are: **Mrs. Gaskell,** authoress of *Mary Barton;* and **Charles Kingsley,** author of *Alton Locke, Westward Ho, Hereward le Wake,* etc.; and **Anthony Trollope,** author of *Barchester Towers* and several other fictions relating to English clerical and domestic life.

Of living writers of fiction the following are some of the most popuiar: **Charles Reade,** author of *It is Never too Late to*

Mend, the *Cloister and the Hearth*, etc.; **Mrs. Oliphant**, authoress of *Salem Chapel*, *Chronicles of Carlingford*, etc.; **Miss Braddon**, authoress of *Lady Audley's Secret*, *Aurora Floyd*, and other tales, mostly of a sensational character; and **Miss Yonge**, authoress of *The Heir of Redclyffe*, the *Daisy Chain*, and other works portraying quiet, domestic English life.

OTHER RECENT AUTHORS.

The following is a list of historians and other authors now living, or lately deceased :—

Dr. John Lingard (1771–1851), a Roman Catholic priest, wrote a *History of England*, which, though bearing marks of the author's theological opinions, is written with great literary skill, and is regarded by all parties as a valuable contribution to the historical literature of the country.

Sir William Francis Patrick Napier (died in 1860), author of the *History of the Peninsular War*, the best military history in the English language.

Sir Archibald Alison (died in 1867), author of the *History of Europe* from the period of the French Revolution to the accession of Napoleon III. It is a very bulky work, and is not much read.

John Keble (died in 1866), a religious poet, author of *The Christian Year.*

John Ruskin, art critic, and author of *Stones of Venice; Modern Painters*, etc. His style is graceful and musical.

Algernon Charles Swinburne, a graceful lyric poet, and author of *Atalanta in Calydon*, *Chastelard*, etc.

William Morris, a pleasing poet, author of *Jason*, *The Earthly Paradise*, etc.

Matthew Arnold, son of Dr. Arnold, of Rugby, an essayist and poet.

Alexander William Kinglake (born 1802) gained considerable fame by *Eothen*, a lively and descriptive account of his

travels in the East. He has since still further increased his reputation by his history of *The Invasion of the Crimea.*

James Anthony Froude (born 1818) is known as the author of a *History of England from the Fall of Wolsey to the Defeat of the Spanish Armada.*

While treating of the English language, and of our great writers, the author of the "Pupil Teachers' Course," in this concluding volume, would desire again to impress on young students the great importance of cultivating a taste for reading. Text-books alone are not sufficient to make a really educated person. They will not by themselves even enable pupil teachers to answer *every* question contained in the Examination Papers. Sometimes a question is given which requires a considerable amount of general reading in order to do it justice. Besides, the object of acquiring knowledge is not simply to pass examinations. Such a view of learning is nothing less than a desecration of it. A love for reading, and a steady, earnest pursuit of knowledge will not only give the student the power of passing examinations; it will do far more than this, it will tend to make him wiser, happier, and better.

In addition to his ordinary text-books, a pupil teacher should never be without some thoroughly good standard work, either in poetry or prose, selected from the writings of our best authors, to read in his leisure hours, as he can spare time during the intervals of study. We have already given lists of such works, and the pupil teacher can always look to the head teacher of the school to which he is attached for guidance in his selection. The practice of thus supplementing his ordinary studies by a course of general reading, will not only prove most valuable in itself, it will give him a greatly increased power of application to his ordinary subjects, which will be far better understood when the intellect has been enlarged by contact with the minds of our great writers.

One final word of caution may here be added. The young student should not read works of inferior merit. There is no

need to do so. English literature is so rich, that there is no fear of exhausting the boundless supply of noble works of genius which it affords. Low, worthless novels should especially be avoided. They waste time, enervate the mind, degrade the taste, and draw away the thoughts from serious and profitable studies. There are, however, many excellent works of fiction which the pupil teacher may read with great advantage; but it should be done sparingly, and the selection should be made with care and after consultation with the head teacher.

[NOTE.—The student should draw up for himself lists of authors in each reign, century, and line of sovereigns. This can easily be done from the dates furnished.]

QUESTIONS FOR EXAMINATION.

The following questions and exercises are selected from previous Examination Papers. Occasional answers and notes are given.

(1) What are the various sources which have contributed to form the English language? and can these various sources be themselves traced back to a common origin?

(2) What is meant by the Scandinavian element in the English language? Can you mention any traces of it to be found in the language we speak now?

(3) What language was spoken in England before the Norman Conquest, and what changes in the language followed from that event?

(4) Mention any words of Celtic origin that occur in our language, and give the reason why so few words from this source are to be found.

(5) What is the word "that" used for in the following? Parse it fully. "I may do that I shall be sorry for."

(6) The English tongue belongs to the Teutonic family of languages, but it contains a great many words derived from other sources. What are these sources? Give examples.

(7) "Peace, brother; *be* not over exquisite
To cast the fashion of uncertain evils;
For grant they *be* so; while they rest unknown,
What need a man forestall his date of grief,
And run to meet *what* he would most avoid?
Or if they be *but* false alarms of fear
How bitter is *such* self-delusion!"

From Milton's "Comus."

(*a*) At what period did Milton write? Give the sense of the above passage in modern English prose

(*b*) Analyse the first two lines.

(*c*) Parse the words in italics.

(8) Give instances of English words borrowed from the Arabic and the Persian.

(9) Analyse the following lines:—

"She *like* a sleeping *infant* lay reclined,
Feeling *no* fear and *all serene* in mind:
While that angelic form *that* moved beside
Seemed some good *spirit* sent to be her *guide*."

Parse the words which are in italics.

SENTENCE.	*Kind.*	*Subject.*	*Predicate.*	*Object.*	*Extension of Pred.*	*Connectives.*
(*a*) She lay reclined, feeling no fear and all serene in mind:	Principal Sentence.	She, feeling no fear and all serene in mind,	lay		reclined,	
(*b*) like a sleeping infant,	Adv. Sent. (*manner*) to (*a*)	a sleeping infant	(lies)			like
(*c*) While that angelic form seemed some good spirit sent to be her guide	Adv. Sent. (*time*) to (*a*)	that angelic form	seemed	some good spirit sent to be her guide		while
(*d*) that moved beside.	Adj. Sent. to (*c*).	that	moved		beside	

like	Conjunctive adverb.
infant	Com. noun, sing., masc. or fem. gend., nom. case, to "lies" understood.
no	Adjective, qualifying "fear."
all	Adjective, used adverbially, qualifying "serene."
serene	Adjective, qualifying "she."
that	Relative pronoun, sing., neut., nom. case to "moved," agreeing with its antecedent "form."
spirit	Com. noun, sing., masc. or fem. gend., nom. case, after the intrans. verb "seemed."
guide	Com. noun, sing., masc. or fem. gend., nom. case, after the verb "to be," which causes it to be in the same case as "spirit."

(10) When was the English language brought into Britain? And name with as much exactness as you can the tribes who brought it.

(11) In what respects chiefly did Anglo-Saxon or early English differ *in form* from modern English?

(12) Analyse the following lines, and parse the words which are in italics :—

"*All* suddenly the hill his snow devours,
In lieu *whereof* a goodly garden grew,—
As if the snow had melted into flowers,
Which their sweet *breath* in subtile vapours *threw*."

(13) "The third *day* comes a frost, a killing frost;
And when he thinks, good easy *man*, *full* surely
His *greatness* is a-ripening, *nips* his root,
And then he falls as I do."

Analyse the above lines, and parse the words which are in italics.

(14) "As we paced along
Methought that Gloucester stumbled, and in *falling*,
Struck me *that thought* to save him *overboard*."

Analyse the above lines, and parse the words which are in italics.

Sentence.	*Kind.*	*Subject.*	*Predicate.*	*Object.*	*Extension of Pred.*	*Connectives.*
(*a*) As we paced along	Adv. Sent. (*time*) to (*b*).	we	paced		along	as
(*b*) Methought	Principal Sentence.	(it)	thought (=seemed)		(to) me	
(*c*) that Gloucester stumbled	Subst. Sentence subj. to (*b*).	Gloucester	stumbled			that
(*d*) and in falling struck me overboard,	Subst. Sentence to (*b*) co-ord. with (*c*).	(Gloucester)	struck	me	in falling, overboard	and (that)
(*e*) that thought to save him.	Adj. Sent. to (*d*).	that	thought	to save him		

As	Conjunctive adverb, introducing the following subordinate sentence.
methought	Equivalent to "it thought (= seemed) to me;" the first element "me" is an old Saxon dative case; the second element is the impersonal verb "thought," which is the Saxon *thúhte*, preterite tense of *thincan*, to seem or appear.
falling	Participial noun, or gerund, formed from the verb "to fall," obj. case, gov. by "in."
that	Equivalent to "who." Relative pronoun, 1st pers. sing., masc., nom. to "thought," agreeing with its antecedent "me."

thought	Irreg. intrans. verb, past tense, indic. mood, 1st pers. sing., agreeing with its nom. "that."
overboard	Adverb, compounded of a preposition and a noun, qualifying "struck."

(15) "If the rain *be prolonged* the Phuleli *becomes* a large *river*, which in Europe might claim very high rank; and at the first inundation the people *begin irrigating* the *lands*."

Analyse the above passage, and parse fully the words which are in italics.

(16) What is a *hybrid word*? Give instances of such words in English, and trace the derivation of such of them as you can.

(17) Analyse the following passage, and parse the words which are in italics:—

"But, *as* often happens, *good* sprang out of evil, and this *very* fire became a *blessing* by burning out the *dregs* of the plague."

Note.—Supply the ellipsis thus, "As (it) often happens."

"Dregs" is governed by "burning." "Out" is an adverb to "burning."

(18) "Alas! how light a cause may move
Dissension between hearts that *love*;
Hearts that the world in vain had tried
And sorrow *but* more closely *tied*,
That stood the storm when waves were rough,
Will yet in sunny hours fall off."

Analyse the above lines, and parse the words which are in italics.

(19) "Star, *that* bringest home the bee
And *sett'st* the weary labourer *free*,
If any star *shed* peace 'tis thou,
Appearing when heaven's breath and brow
Are sweet as *hers* we *love*."

Analyse the foregoing lines, and parse the words in italics.

Sentence.	*Kind.*	*Subject.*	*Predicate.*	*Object.*	*Extension of Predicate.*	*Connectives.*
(*a*) Star, 'tis thou appearing	Principal Sentence.	it	is thou, (O) Star, appearing			
(*b*) that bringest home the bee	Adj. Sent. to (*a*).	that	bringest	the bee	home	
(*c*) and sett'st the weary labourer free	Adj. Sent. to (*a*) co-ord. with (*b*).	(that)	sett'st	the weary labourer	free	and
(*d*) If any star shed peace	Adv. Sent. (*condition*) to (*a*).	any star	shed	peace		If
(*e*) when heaven's breath and brow are sweet	Adv. Sent. (*time*) to (*a*).	heaven's breath and brow	are sweet			when
(*f*) as hers	Adv. Sent. (*degree*) to (*e*).	hers	(are sweet)			as
(*g*) we love.	Adj. Sent. to (*f*).	we	love	(whom)		

that	Relative pronoun, 2nd pers. sing., neut., nom. to "bringest," agreeing with its nom. "star."
sett'st	Irreg. trans. verb, pres., indic., 2nd pers. sing., agreeing with its nom. "that" understood.
free	Adjective of quality, qualifying "labourer." This word has also an adverbial force, since it qualifies the verb "set."
shed	Irreg. trans. verb, pres., subjunctive, 3rd pers. sing., agreeing with its nom. "star."
hers	Pronominal adjective, or possessive pronoun, with the noun not expressed in modern English. Understand thus: "sweet as (the breath and brow) *of her* (whom) we love."
love	Reg. trans. verb, pres. indic., 1st pers. plur., agreeing with its nom. "we," and having for its object the relative pronoun "whom" understood.

(20) Analyse the following passage, and parse fully the words which are in italics :—"*Most* of the lower animals, though they *cannot reason* by general notions, *possess* means of communication by sounds, *which* in a certain sense *constitute* language."

(21) What are the natural stages of our language? and how may they be designated? Also mention the principal names of those who wrote in Anglo-Saxon.

(22) State all the particulars with which you are acquainted about *Piers Ploughman's Vision.*

The full title of this poem is, "The Vision of William, concerning Piers the Ploughman." It was written about the middle of the fourteenth century, by a monk named William Langley, Langland, or Langlande. It is a long poem, which describes the author as having fallen asleep on the Malvern Hills, and seen visions in which Piers the Ploughman appeared to him. During the progress of the allegory the author, in vigorous English of that period, denounces the vices of society during the times in which he lived. Various characters are introduced, chiefly personifications of virtues and vices, such as Reason, Mercy, Truth, Anima (the soul), Covetousness, Envy, etc. In the course of the vision the author, through the agency of these allegorical personages, fiercely attacks the dissolute lives of the ecclesiastics, and the corruptions of society in general. It is supposed to have occupied the poet about thirty years in writing. It is a work of high merit, and of great importance as illustrating the growth of the English language and presenting a lively picture of the social life of the period.

(23) Analyse the following sentence, and parse the words in italics :—

"I had *but just* arrived from Arpinum *when* Tiro gave *me* the *letters that* you had sent."

(24) Mention any four words in our language that are evidently of Latin origin, and four that are evidently of Anglo-Saxon.

(25) "It will be acknowledged, *even* by those who practize it not, that *cleare* and round dealing is the *Honour* of *Man's*

nature; and that mixture of Falsehood is like *Allay* in Coyne of Gold or Silver; *which may make the metall worke the better*, but it embaseth it."—LORD BACON.

(*a*) Point out any old-fashioned words or spellings to be noticed in the above. (*b*) Give the sense of the passage in your own words. (*c*) Point out the adverbial and the noun sentences. (*d*) Parse the words in italics.

(26) Give an example of a complex sentence with a principal and two subordinate sentences, one adjective and one adverbial.

(27) "Lords and Commons of England! *consider what nation it is, whereof ye are*, and whereof ye are the governors;—a nation not *slow* and *dull*, but of a quick, ingenious, and piercing spirit; acute to invent, subtile and sinewy to discourse, not beneath the reach of any point, *the highest* that human capacity can *soar to*."—MILTON.

(*a*) Who are meant by the Commons of England?

(*b*) Give the sense of the above passage in your own words.

(*c*) Analyse it as far as the first semicolon.

(*d*) Parse the words in italics.

(*e*) Point out any words of Latin origin that occur in the above passage, and, where you can, give the derivation of the word.

(*a*) The House of Commons, consisting of the representatives of the people of England, sent up to Parliament to assist in making the laws and governing the country.

(*b*) Members of the Houses of Lords and Commons! remember what kind of nation is that to which you belong, and of which you are the rulers;—a nation not inactive and sluggish, but naturally lively, intelligent, and discerning; prompt at expedients, penetrating and vigorous of speech, and capable of accomplishing everything, however difficult, which is not absolutely beyond the power of man to perform.

(*c*) (An example of analysis not in the tabular form.)

A. "Lords and Commons of England! consider." Principal Sentence.

(1) *Subject*, "(Ye) Lords and Commons of England!"
(2) *Predicate*, "consider."

B. "What nation it is." Substantive sentence, subordinate to, and forming the *object* of, A.

(1) *Subject*, "it."
(2) *Predicate*, "is what nation."

C. "Whereof ye are." Adjective sentence, subordinate to B, equivalent to "of which ye are," and describing the "nation."

(1) *Subject*, "ye."
(2) *Predicate*, "are whereof."

D. "And whereof ye are the governors." Adjective sentence, subordinate to B, and co-ordinate with C. The connecting word is the co-ordinative conjunction "and."

(1) *Subject*, "ye."
(2) *Predicate*, "are the governors," enlarged by the adjunct "whereof."

(*d*)

Consider	Reg. trans. verb, pres. tense, imperative mood, 2nd pers. plur., agreeing with its nom. "ye" understood.
what	Relative pronominal adjective, qualifying "nation."
nation	Com. noun, sing., neut., nom. after "is." The regular order is, "it is what nation."
it	Personal pronoun used indefinitely as the nominative to the verb "is." Properly speaking "it" refers to "the nation."
is	Irreg. intrans. verb, pres. tense, indic. mood, 3rd pers. sing., agreeing with its nom. "it."
whereof	Equivalent to "of which." "Which" is a relative pronoun, in the objective case, gov. by "of," and agreeing with its antecedent "nation."
ye	Personal pronoun, 2nd pers. plur., nom. to "are."

are	Irreg. intrans. verb, pres. tense, indic. mood, 2nd pers. plur., agreeing with its nom. "ye."
slow, dull	Adjectives of quality, qualifying "nation."
the	Def. article, particularizing "point" understood.
highest	Adjective of quality, superlative deg., qualifying "point" understood.
soar	Reg. intrans. verb, infinitive mood, gov. by "can."
to	Preposition, governing "that" (= which). "To which human capacity can soar."

(*e*)

Commons from Lat. *communis*, common.
consider „ *con*, together (*sedeo*, I sit).
nation „ *natio*, a nation (*natus*, born).
governors „ *guberno*, I govern.
ingenious „ *ingenium*, genius, intellect.
spirit „ *spiritus*, spirit (*spiro*, I breathe).
acute „ *acutus*, sharp.
invent „ *invenio*, I find.
subtle „ *subtilis*, fine, subtle.
discourse „ *discursus*, running about (*dis*, asunder; *curro*, I run).
point „ *punctum*, a point (*pungo*, I prick).
human „ *humanus*, human (*homo*, a man).
capacity „ *capax*, able to contain (*capio*, I take).

(28) O'er wayward childhood *wouldst thou hold* firm rule,
And *sun thee* in the light of happy faces?
Love, hope, and patience, these *must be* thy graces,
And in thine own heart they must first *keep* school."
Coleridge.

(*a*) Write out the meaning of the above passage in your own words.

(*b*) Analyse the last two lines.

(*c*) How many words are there in the above passage of other than Saxon origin.

(*d*) Parse the words in italics.

(29) "How *many thousands* of my *poorest* subjects
Are at this *hour asleep!—Sleep*, gentle *Sleep*,
Nature's soft nurse, how have I frighted thee
That thou no more *wilt weigh* my eyelids *down*,
And steep my senses in forgetfulness?"

Shakspeare.

(*a*) Analyse the second sentence in the above.

(*b*) Parse the words in italics.

(30) Explain the following sentence:—"The English is a composite language, based on the Anglo-Saxon."

(31) "Sometime this world was *so* steadfast and stable
That man's word was held obligation;
And now it is so false and deceivable
That word and work . . .
Be nothing one; for turnèd up so *down*
Is all this *world*, through meed and wilfulness,
That all is *lost* for lack of steadfastness."

Chaucer.—Ballad sent to King Richard.

(*a*) Give the meaning of the above passage in simple English of the present day.

(*b*) Explain all the old-fashioned words that occur in the passage.

(*c*) Point out any words in the above which show that the English language, as Chaucer used it, was not pure Saxon.

(*d*) Parse the words in italics.

(*e*) Point out and analyse the adverbial sentences in the above.

RECITATION.

We have selected three passages from Shakspere's comedy "As You Like It," and one from Milton's "Samson Agonistes." From these extracts the Pupil Teacher at the end of the fourth year will be able to select the lines from Shakspere or Milton to be recited on the occasion of the Inspector's visit. A large and varied selection of extracts (carefully annotated) from these two authors will be found in Moffatt's Shakspere and Milton Reader, price 1*s.* 4*d.*

Scenes from "As You Like It."

[The Duke has been driven from his dominions by Frederick, his brother. He goes, with some of his faithful lords, to live in banishment in the beautiful Forest of Arden.]

I.

SCENE: *The Forest of Arden.*

Enter DUKE *Senior*, AMIENS, *and other Lords, in the dress of Foresters.*

Duke S. Now, my co-mates, and brothers in exile,
Hath not old custom made this life more sweet
Than that of painted pomp? Are not these woods
More free from peril than the envious court?

Here feel we but the penalty of Adam,
The season's difference; as the icy fang
And churlish chiding of the winter's wind,—
Which, when it bites and blows upon my body,
Even till I shrink with cold, I smile, and say,—
This is no flattery: these are counsellors,
That feelingly persuade me what I am.
Sweet are the uses of adversity,
Which, like the toad, ugly and venomous,
Wears yet a precious jewel in his head;
And this our life, exempt from public haunt,
Finds tongues in trees, books in the running brooks,
Sermons in stones, and good in everything.

Ami. I would not change it. Happy is your grace,
That can translate the stubbornness of fortune
Into so quiet and so sweet a style.

Duke S. Come, shall we go and kill us venison?
And yet it irks me, the poor dappled fools,—
Being native burghers of this desert city,—
Should, in their own confines, with forked heads
Have their round haunches gored.

1 *Lord.* Indeed, my lord,
The melancholy Jaques grieves at that;
And, in that kind, swears you do more usurp
Than doth your brother, that hath banish'd you.
To-day, my lord of Amiens and myself
Did steal behind him, as he lay along
Under an oak, whose antique root peeps out
Upon the brook that brawls along this wood:
To the which place a poor sequester'd stag,
That from the hunter's aim had ta'en a hurt,
Did come to languish; and, indeed, my lord,
The wretched animal heaved forth such groans,
That their discharge did stretch his leathern coat
Almost to bursting; and the big round tears

Coursed one another down his innocent nose
In piteous chase; and thus the hairy fool,
Much marked of the melancholy Jaques,
Stood on the extremest verge of the swift brook,
Augmenting it with tears.

Duke S. But what said Jaques?
Did he not moralize this spectacle?

1 *Lord.* O, yes, into a thousand similes.
First, for his weeping in the needless stream:
Poor deer, quoth he, *thou makest a testament*
As worldlings do, giving thy sum of more
To that which had too much. Then being there alone,
Left and abandon'd of his velvet friends:
'Tis right, quoth he; *thus misery doth part*
The flux of company. Anon, a careless herd,
Full of the pasture, jumps along by him,
And never stays to greet him: *Ay*, quoth Jaques,
Sweep on, you fat and greasy citizens;
'Tis just the fashion: Wherefore do you look
Upon that poor and broken bankrupt there?
Thus most invectively he pierceth through
The body of the country, city, court,
Yea, and of this our life: swearing that we
Are mere usurpers, tyrants, and what's worse,
To fright the animals, and to kill them up,
In their assign'd and native dwelling place.

Duke S. And did you leave him in this contemplation?

2 *Lord.* We did, my lord, weeping, and commenting
Upon the sobbing deer.

Duke S. Show me the place;
I love to cope him in these sullen fits,
For then he's full of matter.

2 *Lord.* I'll bring you to him straight. [*Exeunt.*

NOTES.

(*The numbers refer to the lines.*)

6 *fang;* tusk, pointed tooth (like a serpent's). A.S. *fangan* or *fón*, to seize.

7 *churlish;* ill-tempered. Properly boorish, rustic. A.S. *ceorl*, a countryman, clown.

12 *uses;* experiences. Or perhaps customs.

14 *jewel;* some of the ancients believed that the head of the toad contains a precious stone.

15 *exempt;* free.

23 *burghers;* townsmen, citizens. A.S. *burh*, or *burg*, a town.

24 *confines;* bounds, limits. Lat. *finis*, an end, boundary.

34 *sequester'd;* separated from the herd, solitary. F. *sequestrer*, to lay aside.

50 *worldling;* one given up to the world and its pleasures.

54 *flux;* flowing together, assembling, gathering. Lat. *fluo*, I flow.

60 *invectively;* sharply, severely.

70 *cope;* encounter, come upon.

II.

[Adam, an old servant, comes to warn his young master, Orlando, to flee for his life. Orlando's brother, Oliver, has formed a design to murder him.]

SCENE: *Before* OLIVER'S *House.*

Enter ORLANDO *and* ADAM, *meeting.*

Orl. Who's there?

Adam. What! my young master?—O my gentle master,
O my sweet master, O you memory
Of old Sir Rowland! why, what make you here?

Why are you virtuous? Why do people love you?
And wherefore are you gentle, strong, and valiant?
Your praise is come too swiftly home before you.
Know you not, master, to some kind of men
Their graces serve them but as enemies?
No more do yours; your virtues, gentle master,
Are sanctified and holy traitors to you.
O, what a world is this, when what is comely
Envenoms him that bears it!

Orl. Why, what's the matter?

Adam. O unhappy youth,
Come not within these doors; within this roof
The enemy of all your graces lives:
Your brother—(no, no brother; yet the son—
Yet not the son—I will not call him son—
Of him I was about to call his father)—
Hath heard your praises; and this night he means
To burn the lodging where you use to lie,
And you within it; if he fail of that,
He will have other means to cut you off:
I overheard him, and his practices.
This is no place, this house is but a butchery;
Abhor it, fear it, do not enter it.

Orl. Why, whither, Adam, wouldst thou have me go?

Adam. No matter whither, so you come not here.

Orl. What, wouldst thou have me go and beg my food?
Or with a base and boisterous sword, enforce
A thievish living on the common road?
This I must do, or know not what to do:
Yet this I will not do, do how I can;
I rather will subject me to the malice
Of a diverted blood, and bloody brother.

Adam. But do not so; I have five hundred crowns,
The thrifty hire I saved under your father,

Which I did store, to be my foster nurse,
When service should in my old limbs lie lame,
And unregarded age in corners thrown;
Take that: and He that doth the ravens feed,
Yea, providently caters for the sparrow,
Be comfort to my age! Here is the gold;
All this I give you. Let me be your servant;
Though I look old, yet I am strong and lusty:
For in my youth I never did apply
Hot and rebellious liquors in my blood;
Nor did not with unbashful forehead woo
The means of weakness and debility;
Therefore my age is as a lusty winter,
Frosty, but kindly: let me go with you;
I'll do the service of a younger man
In all your business and necessities.

Orl. O good old man; how well in thee appears
The constant service of the antique world,
When service sweat for duty, not for meed!
Thou art not for the fashion of these times,
Where none will sweat but for promotion;
And having that, do choke their service up
Even with the having: it is not so with thee.
But, poor old man, thou prun'st a rotten tree,
That cannot so much as a blossom yield,
In lieu of all thy pains and husbandry:
But come thy ways, we'll go along together;
And ere we have thy youthful wages spent,
We'll light upon some settled low content.

Adam. Master, go on, and I will follow thee
To the last gasp, with truth and loyalty.—
From seventeen years till now, almost fourscore,
Here lived I, but now live here no more.
At seventeen years many their fortunes seek;
But at fourscore it is too late a week:

Yet fortune cannot recompense me better
Than to die well, and not my master's debtor.

[*Exeunt.*

NOTES.

3 *memory;* remembrance, reminder, that which reminds of or calls to memory.

10 *no more do yours; i.e.*, nor do *your* graces (or merits) serve you as anything more than enemies, they raise up jealousy against you.

13 *envenoms;* poisons, injures. Lat. *venenum*, poison.

22 *use;* are accustomed.

31 *boisterous;* violent.

36 *diverted;* turned out of the course of nature, unnatural. Lat. *dis*, asunder, *verto*, I turn.

43 *caters;* provides.

57 *meed;* reward, pay. A.S. *méd*, pay.

III.

[Orlando and Adam flee from their homes and arrive in the Forest of Arden. The old man is oppressed with hunger and fatigue, and Orlando leaves him for a short time to seek food for him. He comes to the place where the Duke and his friends are about to commence eating.]

SCENE: *The Forest.—A table set out.*

DUKE, AMIENS, JAQUES, *Lords, and others.*

Enter ORLANDO, *with his sword drawn.*

Orl. Forbear, and eat no more.

Jaq. Why, I have eat none yet.

Orl. Nor shalt not, till necessity be served.

Jaq. Of what kind should this fellow come of?

Duke. Art thou thus bolden'd, man, by thy distress:
Or else a rude despiser of good manners,
That in civility thou seem'st so empty?

Orl. You touched my vein at first; the thorny point
Of bare distress hath ta'en from me the show
Of smooth civility: yet am I inland bred,
And know some nurture: But forbear, I say;
He dies that touches any of this fruit,
Till I and my affairs are answered.

Jaq. An you will not be answered with reason,
I must die.

Duke. What would you have? Your gentleness shall force
More than your force move us to gentleness.

Orl. I almost die for food, and let me have it.

Duke. Sit down and feed, and welcome to our table.

Orl. Speak you so gently? Pardon me, I pray you:
I thought that all things had been savage here;
And therefore put I on the countenance
Of stern commandment. But whate'er you are,
That in this desert inaccessible,
Under the shade of melancholy boughs,
Lose and neglect the creeping hours of time;
If ever you have look'd on better days,
If ever been where bells have knoll'd to church,
If ever sat at any good man's feast,
If ever from your eyelids wiped a tear,
And know what 'tis to pity and be pitied,
Let gentleness my strong enforcement be:
In the which hope I blush, and hide my sword.

Duke. True is it, that we have seen better days,
And have with holy bell been knoll'd to church,
And sat at good men's feasts, and wiped our eyes
Of drops that sacred pity hath engender'd:
And therefore sit you down in gentleness,

And take upon command what help we have,
That to your wanting may be minister'd.

Orl. Then, but forbear your food a little while,
Whiles, like a doe, I go to find my fawn,
And give it food. There is an old poor man
Who after me hath many a weary step
Limp'd in pure love; till he be first sufficed,—
Oppress'd with two weak evils, age and hunger,—
I will not touch a bit.

Duke. Go find him out,
And we will nothing waste till your return.

Orl. I thank ye; and be bless'd for your good comfort! [*Exit.*

Duke. Thou see'st, we are not all alone unhappy:
This wide and universal theatre
Presents more woeful pageants than the scene
Wherein we play in.

Jaq. All the world's a stage,
And all the men and women merely players:
They have their exits, and their entrances;
And one man in his time plays many parts,
His acts being seven ages. At first, the infant,
Mewling and puking in the nurse's arms.
And then the whining school-boy, with his satchel,
And shining morning face, creeping like snail
Unwillingly to school. And then the lover,
Sighing like furnace, with a woeful ballad
Made to his mistress' eye-brow. Then a soldier
Full of strange oaths, and bearded like the pard,
Jealous in honour, sudden and quick in quarrel,
Seeking the bubble reputation
Even in the cannon's mouth. And then the justice,
In fair round belly, with good capon lined,
With eyes severe, and beard of formal cut,
Full of wise saws and modern instances,

And so he plays his part. The sixth age shifts
Into the lean and slipper'd pantaloon;
With spectacles on nose, and pouch on side;
His youthful hose well saved, a world too wide
For his shrunk shank; and his big manly voice,
Turning again toward childish treble, pipes
And whistles in his sound. Last scene of all,
That ends this strange eventful history,
Is second childishness, and mere oblivion;
Sans teeth, sans eyes, sans taste, sans everything.

Re-enter ORLANDO *with* ADAM.

Duke. Welcome. Set down your venerable burden,
And let him feed.

Orl. I thank you most for him.

Adam. So had you need;
I scarce can speak to thank you for myself.

Duke. Welcome, fall to; I will not trouble you
As yet, to question you about your fortunes.—
Give us some music; and, good cousin, sing.

NOTES.

8 *touched my vein;* found out the state of my mind and feelings.

10 *inland bred;* brought up in civilized society, not in upland districts or in a small island, outside the great world.

11 *nurture;* Lat. *nutrio,* I nourish; bringing up, breeding, education.

37 *engender'd;* Lat. *in, genero,* I breed; *genus,* a race; brought forth, produced.

53 *pageant;* show, spectacle.

60 *mewling and puking;* crying and vomiting.

66 *pard;* leopard, or panther.

72 *saws;* sayings.
modern; common.
74 *pantaloon;* a ridiculous old character in a pantomime.
79 *his;* for *its.* The latter word had not come into use in Shakspere's time.
82 *sans;* French for "without."

Extract from "Samson Agonistes."

BY JOHN MILTON.

"Samson Agonistes" is a dramatic work founded on the history of Samson as related in the Book of Judges. In the following scene a messenger relates to Manoah, father of Samson, the death of the latter.

MANOAH; *to him enter* MESSENGER.

Mess. Oh, whither shall I run, or which way fly
The sight of this so horrid spectacle,
Which erst my eyes beheld, and yet behold?
For dire imagination still pursues me.
But Providence or instinct of nature seems,
Or reason, though disturb'd, and scarce consulted,
To have guided me aright, I know not how,
To thee first, reverend Manoah, and to these
My countrymen, whom here I knew remaining,
As at some distance from the place of horror,
Though in the sad event too much concern'd.

Man. The accident was loud, and here before thee,
With rueful cry, yet what it was we hear not;
No preface needs, thou seest we long to know.

Mess. It would burst forth, but I recover breath,
And sense distract, to know well what I utter.

Man. Tell us the sum, the circumstance defer.

Mess. Gaza yet stands, but all her sons are fallen,
All in a moment overwhelm'd and fallen.
Man. Sad! but thou know'st to Israelites not saddest
The desolation of a hostile city.
Mess. Feed on that first; there may in grief be surfeit.
Man. Relate by whom.
Mess. By Samson,
Man. That still lessens
The sorrow, and converts it nigh to joy.
Mess. Ah! Manoah, I refrain too suddenly
To utter what will come at last too soon;
Lest evil tidings, with too rude irruption,
Hitting thy aged ear, should pierce too deep.
Man. Suspense in news is torture; speak them out.
Mess. Take then the worst, in brief: Samson is dead.
Man. The worst, indeed! Oh, all my hopes defeated
To free him hence! but death, who sets all free,
Hath paid his ransom now, and full discharge.
What windy joy this day had I conceived,
Hopeful of his delivery, which now proves
Abortive as the first-born bloom of spring,
Nipt with the lagging rear of winter's frost!
Yet ere I give the reins to grief, say, first,
How died he? death to life is crown or shame.
All by him fell, thou say'st; by whom fell he?
What glorious hand gave Samson his death's wound?
Mess. Unwounded of his enemies he fell.
Man. Wearied with slaughter, then, or how? explain.
Mess. By his own hands.
Man. Self-violence? what cause
Brought him so soon at variance with himself
Among his foes?
Mess. Inevitable cause,
At once both to destroy and be destroy'd;

The edifice, where all were met to see him,
Upon their heads and on his own he pull'd.
Man. O, lastly over-strong against thyself!
A dreadful way thou took'st to thy revenge.
More than enough we know; but while things yet
Are in confusion, give us, if thou canst,
Eye-witness of what first or last was done,
Relation more particular and distinct.
Mess. Occasions drew me early to this city;
And, as the gates I enter'd with sunrise,
The morning trumpets festival proclaim'd
Through each high street: little I had despatch'd,
When all abroad was rumour'd that this day
Samson should be brought forth to show the people
Proof of his mighty strength in feats and games;
I sorrow'd at his captive state, but minded
Not to be absent at that spectacle.
The building was a spacious theatre,
Half round, on two main pillars vaulted high,
With seats where all the lords, and each degree
Of sort might sit in order to behold;
The other side was open, where the throng
On banks and scaffolds under sky might stand;
I, among these, aloof obscurely stood.
The feast and noon grew high, and sacrifice
Had fill'd their hearts with mirth, high cheer, and wine,
When to their sports they turn'd. Immediately
Was Samson as a public servant brought,
In their state livery clad: before him pipes
And timbrels; on each side went armèd guards,
Both horse and foot; before him and behind,
Archers and slingers, cataphracts and spears.
At sight of him the people with a shout
Rifted the air, clamouring their god with praise,
Who had made their dreadful enemy their thrall.
He, patient but undaunted, where they led him,

Came to the place ; and what was set before him,
Which without help of eye might be assay'd,
To heave, pull, draw, or break, he still perform'd,
All with incredible, stupendous force ;
None daring to appear antagonist.
At length, for intermission's sake, they led him
Between the pillars ; he his guide requested
(For so from such as nearer stood we heard),
As over-tired, to let him lean awhile,
With both his arms, on those two massy pillars,
That to the arched roof gave main support.
He, unsuspicious, led him ; which, when Samson
Felt in his arms, with head awhile inclined,
And eyes fast fix'd, he stood, as one who pray'd,
Or some great matter in his mind revolved :
At last, with head erect, thus cried aloud :—
" Hitherto, lords, what your commands imposed
I have perform'd, as reason was, obeying,
Not without wonder or delight beheld :
Now, of my own accord, such other trial
I mean to show you of my strength, yet greater,
As with amaze shall strike all who behold."
This utter'd, straining all his nerves, he bow'd.
As with the force of winds and waters pent,
When mountains tremble, those two massy pillars
With horrible convulsion to and fro
He tugg'd, he shook, till down they came, and drew
The whole roof after them with burst of thunder
Upon the heads of all who sat beneath,
Lords, ladies, captains, counsellors, or priests,
Their choice nobility and flower, not only
Of this, but each Philistian city round,
Met from all parts to solemnize this feast.
Samson, with these immix'd, inevitably
Pull'd down the same destruction on himself;
The vulgar only 'scaped who stood without.

NOTES.

3 *erst;* an old word meaning formerly. A.S., *ærest*, soonest, superlative of *ær*, soon.

8 *reverend;* revered, respected, honoured.

13 *rueful;* bitter, mournful.

16 *distract;* distracted, perplexed, confused.

17 *circumstance;* details, particulars.

22 *surfeit;* over-feeding, having more than enough.

27 *irruption;* bursting in. Lat. *in*, *rumpo*, I break, burst.

56 *this city;* Gaza.

63 *minded;* kept in mind, remembered.

77 *timbrel;* tambourine, a kind of drum. Lat. *tympanum* (from Greek), a drum.

79 *cataphract;* a kind of heavy armour made of leather strengthened by scales or links.

82 *thrall;* bondslave. A word of Scandinavian origin.

107 *pent;* penned in, closely confined.

COMPOSITION.

IN the preceding volumes of this Course we have given the young student some hints of a miscellaneous kind in reference to English Composition. In the present volume we propose to enter more fully into this subject, as it is one which is of great importance in itself, and presents difficulties to the beginner which may be considerably lessened by attention to some general rules and principles.

For purposes of composition, the English language exists in the works of its great authors. Hence, to acquire the art of writing that language with correctness and elegance, it is before all things necessary to study the works of eminent English writers. A good prose style cannot possibly be attained without this study. The classical works of our literature form the models of English which must be carefully observed, though not servilely imitated, by the beginner. The famous Greek orator, Demosthenes, is said to have copied out the writings of Thucydides many times, in order to become, as it were, imbued with the style of the great historian. Among the authors whose works may be studied with advantage by students for the purpose of acquiring a good prose style, may be mentioned Addison, Goldsmith, Burke, Macaulay, and the other historians named in the Third Year of this Course. Concerning the first of these authors, Dr. Johnson, in a well-known passage, says: "Whoever wishes to attain an English style, familiar but not coarse, and elegant but not ostentatious, must give his days and nights to the volumes of Addison."

The works of these and other masters of English composition must be read with great care and attention. The thoughts must be weighed and the language minutely examined, the structure of the sentences should be observed, and the manner in which the words produce the effects which the author had in view accurately noted. The style of one author should be compared with that of another. It is a good practice to read aloud. By this means two senses are called into action, the style of the author is impressed on the mind of the reader through the ear as well as the eye, and the elegance and harmony of the periods become more apparent than when they are read in silence. Learning passages by heart is also strongly to be recommended.

The student should always read, if possible, with the assistance of a good dictionary. A small one (containing only the words in general use) is of little service. Every word whose meaning is not known by the reader, or which is used by the author in an unfamiliar sense, should at once be looked out, and its signification and derivation treasured up in the memory. By this means the student will gradually acquire a good supply of words. A person who is in the possession of only a meagre vocabulary, cannot possibly express his thoughts with accuracy, elegance, and force.

It is not sufficient to rely merely on the imitation of good authors. The student who wishes to excel, or perhaps even aspires to be able some day to attain to literary eminence, must exercise his own intelligence. When Opie was asked by a young admirer; "How do you mix your colours?" the celebrated painter gave the oft-quoted answer: "With brains, sir." The reply might have been given with equal force to an inquiry about the composition of sentences. Any attempt to compose good English without the exercise of "brains," will assuredly fail.

Care should be taken to use correct and elegant language, even in the course of ordinary conversation. Boswell tells us that "Johnson used to say, that he made it a constant rule to

talk as well as he could, both as to sentiment and expression, by which means what had been originally effort became familiar and easy."

The first aim of the beginner should be to write grammatically. The rules of grammar have already been given in the volumes of this Course, and it will be unnecessary further to refer to them here. The young student should accustom himself to parse and analyse his own sentences, and give an intelligible account of each word and phrase which he uses, by showing in what relation it stands to the general construction of the sentence and to the other parts of it. By this means, he will acquire accuracy. After a time such aid may be dispensed with. Thus, while a house is being built, it is necessary to erect scaffolding; but this is taken down when the edifice is complete, and the building then stands alone.

We proceed to enter into the subject more in detail, by presenting the chief rules which have been given by eminent authorities for the writing of English.*

The qualities of a good style may be ranged under two heads, namely,—

(1) Those which relate to Perspicuity.

(2) Those which relate to Ornament.

I. PERSPICUITY.

This is the fundamental quality of a good style. The first aim of a writer should be to make himself perfectly understood by his readers. No merits of any other kind, no elegance of language or harmony of diction, can make up for a want of clearness.

Perspicuity of thought and expression may be considered not

* For some of the matter, and many of the examples contained in this chapter we are indebted to Blair's "Lectures," a work which may be studied with great advantage by pupil teachers in the later years of their engagement.

only as a negative virtue, a mere freedom from defect; it is a positive beauty in style, since it adds to the pleasure of the reader, and carries him through the subject with a degree of satisfaction which cannot be derived from the perusal of an obscure composition.

Perspicuity may be considered with reference to (1) Single Words and Phrases, and (2) Sentences.

1. **SINGLE WORDS AND PHRASES.** The qualities required in these are,—

(*a*) **Purity.** Only those words and phrases should be used which properly belong to the language which is being used. English writers sometimes deform their compositions with words, expressions, and idioms borrowed from other languages. Thus we find such words as *café*, *vraisemblance*, *coup-d'œil*, *raison d'être*, *cortège*, *politesse*, *hauteur* (from the French), *effluvium*, *sine quâ non*, *ad captandum*, *cœteris paribus* (from the Latin), *geist*, *father-land* (from the German), constantly occurring in the writings of some authors, and often introduced in the most unnecessary and pedantic manner, as though the author's desire were, not so much to illustrate his subject, as to make a vain display of his own learning. Such words and phrases may sometimes be used with advantage, even in a rich and copious language like the English; but if they are not employed with great moderation and discretion, and only when really necessary for supplying an actual deficiency, they only serve to load the composition with a number of offensive excrescences.

Obsolete words should also be avoided. Modern writers should use *modern* English. It is true that many of our old words have fallen out of use, and that some of them deserved a longer existence; still, since they no longer belong to the language, they ought not to be employed. Such expressions as *quoth he*, *I wist not*, *behest*, *selfsame*, fall under this head.

Provincialisms, or words, phrases, and idioms peculiar to certain counties or districts, must also be avoided, as well as Scotticisms, or forms peculiar to Scotland.

Many objectionable words and phrases have recently been imported from America, as *skedaddle*, *Britisher*, etc. The American fashion of forming verbs from nouns; as, *to interview*, *to cable*, *to wire*, etc., should not be adopted.

Low and vulgar expressions should of course be rejected. There are even many familiar words and phrases allowable in ordinary conversation which are by no means adapted for serious writing. Such expressions as *topsy-turvy*, *currying favour* with any one, *creeping up the sleeve* of any one, *see with half an eye*, *to bolt*, etc., are not to be admitted. The following sentence is faulty in this respect: "Meantime the Britons, left to *shift for themselves*, were forced to call in the Saxons for their defence."

Some authors offend against purity of language by coining words in an injudicious manner. Only writers who have attained to the highest eminence possess the right of coining words at all; and even by these it should be done with great judgment and discretion. Some authors affect a German style, and form compound words by joining several smaller ones together in a manner which is utterly foreign to the genius of the English language. Such expressions as, *The-never-to-be-forgotten* day, *birth-land*, *time-element*, are not English at all.

(*b*) **Propriety.** It is not sufficient that a writer should employ only words and phrases which really belong to the language. Those which *are* used should be judiciously selected, with due regard to the exact meaning the author wishes to convey. A style may be pure and yet deficient in propriety, since the words and phrases may be ill chosen, not adapted to the subject, nor fully expressive of the author's ideas. The following remarks apply to the subject of propriety.

Such words and phrases should be employed as are suitable to the subject. If it be of a common and familiar kind, simple words, more particularly those of Saxon origin, should be used; while in compositions of a more elevated kind, and addressed to a more learned class of readers, less familiar words, those especially which are derived from Latin and Greek sources, are

more suitable, and often indeed absolutely indispensable. The difference referred to may be illustrated by comparing the simple language of Bunyan's Pilgrim's Progress with the lofty and classical style of Gibbon's History of the Decline and Fall of the Roman Empire.

Technical terms, those which are peculiar to various arts and sciences, should be very sparingly used in ordinary compositions. Scientific terms, nautical phrases (as *tack to the larboard, sweep the anchor*, etc.), are out of place when addressed to general readers, though necessary in works treating of the subjects to which they belong.

The same word should not be repeated too often in the same sentence or paragraph. The sense should not however be sacrificed in order to avoid a repetition of this kind. Lord Macaulay is rather fond of repeating the same word, for the sake of emphasis. "*We* admire his genius; *we* love the kind nature which appears in all his writings; and *we* cherish his memory as much as if *we* had known him personally. But *we* must plainly say," etc. The young student should be careful in imitating sentences of this kind. Only a practised writer can venture on such repetitions with safety, and if they are not accompanied with good taste, the effect is very disagreeable. In giving mere lists of places or facts, repetitions of words are not generally objectionable, and sometimes are scarcely to be avoided.

(*c*) **Precision.** The words employed should express exactly what the author means. There should be no doubt or difficulty whatever in the mind of the reader as to the precise sense which the words are intended to convey.

Equivocal or ambiguous words should be avoided. An author writes: "As for such animals as are *mortal* or noxious, we have a right to destroy them." Here the term *mortal* (intended to convey the idea of "deadly") also means "subject to death," and the sense is confused. In the sentence, "I long since learned to like nothing but what you *do*," the phrase *what you do* may mean either "what you like" or "what you per-

form." Again, "He aimed at *nothing less* than the crown" may signify either, "Nothing was less aimed at by him than the crown," or, "He even aimed at the possession of the crown."

The use of exaggerated language should be avoided. Some persons are very fond of using such words as *tremendous*, *awful*, *prodigious*, where much milder terms would be sufficient to convey the degree of intensity they wish to impart to the ideas they have in their minds. If expressions of such extreme force be used to denote only moderate degrees of the qualities referred to, there are none left for the purpose of describing facts and feelings of a really excessive or extraordinary nature.

Great care should be exercised in the proper use of terms regarded as synonymous, or having the same signification. There are probably no two words exactly synonymous, and the utmost attention must be paid to the precise shades of meaning conveyed by words which resemble each other closely in signification. The following examples will render this more clear:—

Custom, habit. Custom relates to the *action;* habit to the *actor.* By custom we mean the frequent repetition of the same act; by habit the effect which that repetition produces on the mind or body. "By the *custom* of walking often in the streets one acquires a *habit* of idleness."

Haughtiness, disdain. Haughtiness is founded on the high opinion we entertain of ourselves; disdain on the mean opinion we have of others.

Entire, complete. A thing is entire by wanting none of its parts; complete by wanting none of the appendages which belong to it. "The man has an *entire* house to himself, but there is not one *complete* apartment in it."

Surprised, astonished, amazed, confounded. We are surprised with what is new or unexpected, astonished at what is vast or great, amazed at what is incomprehensible, confounded by what is shocking or terrible.

Let the young student try the effect, in a beautiful passage from some good author, of taking out some word and substituting for it some other which *appears* to have just the same

meaning. "Act" and "do" seem to mean the same thing, but if in the lines

"Let us then be up and *doing*"

and

"But to act that each to-morrow
Finds us further than to-day"

we substitute one for the other, we have destroyed both the beauty and the sense, and we have

"Let us then be up and *acting*,"
"But to *do* that each to-morrow
Finds us further than to-day."

2. **SENTENCES.** In order to attain perspicuity it is necessary not only to attend to a right choice of words, but also to their proper arrangement in sentences. In relation to this subject, a sentence should have the following qualities :—

(*a*) Clearness and Precision. (*b*) Unity. (*c*) Strength.

(*a*) **Clearness and Precision.** Obscurity arises not only from a wrong choice of words, but from an incorrect arrangement of them. Thus in the sentence, "The rising tomb a lofty column bore," it is doubtful whether the tomb bore the column or the column bore the tomb. Again: "And thus the son the fervent sire addrest" is obscure, because we do not know whether the son addrest the sire or the sire the son. Here the want of perspicuity arises from the sentences not being arranged according to the proper order of subject, predicate, and object. If inversions are employed, care should be taken to avoid any ambiguity of meaning.

All the rules of grammar should be carefully observed. Verbs should agree with their nominatives, pronouns with the nouns to which they refer, etc. Young writers should be careful to avoid using a verb in the plural when it comes after two or more nouns which appear at the first glance to be the subject when they are not. "The nature of virtue and vice are not to be understood without careful examination." The verb "are"

is wrong, because its nominative is not "virtue and vice," but "nature." The sentence should be altered to "*is* not to be understood," etc.

Relative pronouns should stand as near to their antecedents as possible. The following sentence is faulty in this respect: "This kind of wit was very much in vogue among our countrymen about an age or two ago, *who* did not practise it for any oblique reason, but purely for the sake of being witty." It should be arranged thus: "About an age or two ago, this kind of wit was very much in vogue among our countrymen, who did not," etc. The following passage is still worse: "It is folly to pretend to arm ourselves against the accidents of life, by heaping up treasures, *which* nothing can protect us against but the good providence of our Creator." We leave this to be corrected by our young readers.

Personal pronouns should be used with care that it shall be perfectly evident to what noun they refer. The same pronoun should seldom be used in one sentence in reference to two or more distinct nouns. Pronouns are often used very carelessly in the authorized translation of the Bible. Thus, in 2 Kings xix. 35, we have the curious statement that "when *they* arose in the morning, *they* were all dead corpses." Again, in Mark vi. 29 we read that "when *his* disciples heard of it they came and took up *his* corpse." In each of these passages the sense is confused by the second pronoun being made to refer to a different noun from that referred to by the first. The following sentence from Tillotson contains pronouns used in a careless and indistinct manner: "Men look with an evil eye upon the good that is in others, and think that *their* reputation obscures *them*, and *their* commendable qualities stand in *their* light; and therefore *they* do what *they* can to cast a cloud over *them*, that the bright shining of *their* virtues may not obscure *them*."

It is also necessary to arrange the sentence so that each word and member of it shall be in its proper position. Each qualifying word or phrase and each distinct clause should be so placed that its relation to the other parts of the sentence and to

the whole may be at once apparent. The following are examples of confusion arising from a neglect of this rule: "The Romans understood liberty at least as well as we." Here the phrase "at least" might refer to *liberty*, but the author meant to say: "The Romans understood liberty as well, at least, as we." "A great stone that I happened to find, after a long search, by the sea-shore, served me for an anchor." In this sentence it is doubtful whether the *long search* was entirely by the sea-shore, or whether it was also carried on elsewhere. The author's meaning probably was: "A great stone, that, after a long search, I happened to find by the sea-shore, served me for an anchor." "For the English are naturally fanciful, and very often disposed, by that gloominess and melancholy of temper which are so frequent in our nation, to many wild notions and extravagances to which others are not so liable." Here there is an awkward separation of the first part of the assertion, ending with the word "disposed," from the latter. The sentence would run better thus: "For the English are naturally fanciful, and by that gloominess and melancholy of temper which are so frequent in our nation, are often disposed to many wild notions."

Words and expressions should not be left to be understood, unless they can be omitted with perfect clearness. "This generous action greatly increased his former services" should be written: "This generous action greatly increased *the merit of* his former services." So the following sentence is defective: "Arbitrary power I look upon as a greater evil than anarchy itself, as much as a savage is a happier state of life than a slave at the oar." It should be altered to "as much as the *state of life of a* savage is happier than *that* of a slave at the oar."

(*b*) **Unity.** As a rule, a sentence should contain one proposition. It may consist of parts, indeed, but these should be so closely connected as to form a united whole, and produce on the mind the impression of one object, not of many. To preserve the unity of a sentence, the following rules have been given:—

I. During the course of the sentence, let the scene be changed as little as possible. Do not let the mind be hurried by sudden

transitions from person to person, nor from subject to subject. "The sultan being dangerously wounded, they carried him to his tent; and, upon hearing of the defeat of his troops, they put him into a litter, which transported him to a place of safety, at the distance of fifteen leagues." This sentence would be improved by dividing it thus: "The sultan, being dangerously wounded, was carried to his tent. On hearing of the defeat of his troops, he was put into a litter," etc.

II. Do not crowd into one sentence things which have so little connection that they could bear to be divided into two or three sentences. "Archbishop Tillotson," says an author, "died in this year. He was exceedingly beloved by King William and Queen Mary, who nominated Dr. Tenison, bishop of Lincoln, to succeed him." Here we are carried, in the same sentence, from one proposition, "He was beloved by William and Mary," to a quite different one, "They nominated Dr. Tenison to succeed him." The following sentences are still more faulty: "Their march was through an uncultivated country, whose savage inhabitants fared hardly, having no other riches than a breed of lean sheep, whose flesh was rank and unsavoury, by reason of their continual feeding upon salt fish." "To this succeeded that licentiousness which entered with the Restoration, and, from infecting our religion and morals, fell to corrupt our language, which last was not like to be much improved by those who at that time made up the court of King Charles the Second; either such as had followed him in his banishment or who had been altogether conversant in the dialect of those times, or young men who had been educated in the same country: so that the court, which used to be the standard of correctness and propriety of speech, was then, and I think has ever since continued, the worst school in England for that accomplishment; and so will remain, till better care be taken in the education of our nobility, that they may set out into the world with some foundation of literature, in order to qualify them for patterns of politeness." The author, in place of a sentence, has here given a loose dissertation upon several subjects; dif-

ferent facts, reasonings, and observations being all linked together so that they all make parts of one sentence.

III. Keep clear of all unnecessary parentheses. These may sometimes be introduced with propriety, but generally their effect is bad. They are wheels within wheels, sentences in the midst of sentences, and tend to perplex the reader. The following sentence is not to be admired: "If your hearts secretly reproach you for the wrong choice you have made (as there is time for repentance and retreat, and a return to wisdom is always honourable), bethink you that the evil is not irreparable." It would be much better to express in a separate sentence the thoughts contained in this parenthesis.

IV. Bring each sentence to a full and perfect close. A sentence which is not complete is no sentence at all. Sometimes we meet with sentences which are continued, as it were, after they are finished. Some circumstance is added forming a sort of appendage or tail to the sentence, and entirely destroying its unity. For example, Dean Swift writes: "With these writings young divines are more conversant than with those of Demosthenes, who by many degrees excelled the other, at least as an orator." Here the natural close of the sentence is at the words "excelled the other," and the words added mar the effect of the whole.

(*c*) **Strength.** By this is meant such a disposition of the several words and members as shall bring out the sense to the best advantage, render the impression which the period is designed to make most full and complete, and give every word and every member their due weight and force. The following rules have been given in connection with this part of the subject:—

I. Prune the sentence of all redundant words and phrases. They are enfeebling, and make the sentence move along tardily and encumbered. If words do not add to the meaning of a sentence, they tend to injure it. They cannot be superfluous without being hurtful. Thus "Content with deserving a triumph, he refused the honour of it," is better than "*Being* content with

deserving a triumph, he refused the honour of it." Addison, speaking of Beauty, says: "The very first discovery of it strikes the mind with inward joy, and spreads delight through all its faculties." Here little or nothing is added by the second member of the sentence to that which was already contained in the first. An author writes: "I am honestly, seriously, and unalterably of opinion that nothing can possibly be more incurably and emphatically destructive or more decisively fatal to a kingdom than the introduction of thoughtless dissipation and the pomp of lazy luxury." Would not the whole import of this sentence be better expressed thus: "I am of opinion that nothing is more ruinous to a kingdom than luxury and dissipation"?

II. Attend particularly to the use of copulatives and other particles employed for transition and connection. Much of the strength and grace of a sentence often depends on the proper employment of such little but important words, which form the joints or hinges on which the sentence turns. For example, the separation of a preposition from the noun which it governs is to be avoided, as in the following example: "Though virtue borrows no assistance *from*, yet it may often be accompanied *by*, the advantages of fortune." Here there is an awkward separation of two things which, by their nature, should be united.

Some writers needlessly multiply demonstrative and relative particles. Thus we read: "There is nothing which disgusts us sooner than the empty pomp of language." This kind of style may sometimes be proper in an introductory sentence, but, generally speaking, it would be better to write simply: "Nothing disgusts us sooner than the empty pomp of language."

Others omit the relative pronoun when it would be better to express it. In writings of a serious or dignified kind it is generally better not to employ elliptical expressions of this kind: "The man I love," "The dominions we possessed and the conquests we made," instead of: "The man *whom* I love," and "The dominions *which* we possessed and the conquests *which* we made."

The unnecessary use of the particle *and* enfeebles style.

Take the following sentence from Sir Richard Temple, for example: "The Academy set up by Cardinal Richelieu, to amuse the wits of that age and country, and to divert them from raking into his politics and ministry, brought this into vogue; and the French wits have, for this last age, been wholly turned to the refinement of their Style and Language; and, indeed, with such success that it can hardly be equalled, and runs equally through their verse and their prose." Here there are no fewer than eight *ands* in one sentence, which drags along heavily through this careless multiplication of copulatives.

It is worthy of remark, that though the use of the conjunction *and* is naturally to join objects together, and so apparently to make their connection more close, yet in fact we can sometimes mark a more intimate union and a quicker succession of ideas by dropping it altogether. "I came, I saw, I conquered," expresses with more spirit the rapidity and quick succession of conquest than if connecting particles had been used.

Hence it follows that when we seek to prevent a too quick transition from one object to another, when we are making some enumeration in which we wish that the objects should appear as distinct from each other as possible and that the mind should rest for a moment on each object by itself, in this case copulatives may be multiplied with peculiar advantage and grace, as when Bolingbroke says: "Such a man might fall a victim to power; but truth, and reason, and liberty would fall with him." St. Paul's writings furnish a beautiful illustration of this remark, Rom. viii. 38, 39: "I am persuaded that neither death, nor life, nor angels, nor principalities, nor powers, nor things present, nor things to come, nor height, nor depth, nor any other creature, shall be able to separate us from the love of Christ."

III. Dispose the principal word or words in that place of the sentence where they will make the fullest impression. Sometimes they may be placed with most advantage at the beginning, sometimes at the end, sometimes even in the middle. Generally, in English, the beginning of the sentence is the most

appropriate place. Every one has observed the powerful effect produced in the sentence, "Great is Diana of the Ephesians," by commencing with the adjective. "Thus," says Pope, "on whatever side we contemplate Homer, what principally strikes us is his wonderful invention." Here the principal word is placed at the end.

IV. Attend to the *climax* of a sentence when the subject naturally admits of it. The members of the period should go on rising and growing in importance above one another. In the following beautiful passage from Addison we find the sentence thus arranged without affectation or unseasonable pomp: "If we rise yet higher, and consider the fixed stars as so many oceans of flame that are each of them attended with a different set of planets, and still discover new firmaments and new lights, that are sunk farther in those unfathomable depths of ether, we are lost in such a labyrinth of suns and worlds, and confounded with the magnificence and immensity of nature."

V. Avoid concluding a sentence with an adverb, a preposition, or any inconsiderable word. For instance, it is much better to say: "Avarice is a crime of which wise men are often guilty," than, "Avarice is a crime which wise men are often guilty of." In the following sentence from the *Spectator*, which otherwise is abundantly noble, the bad effect of the close is sensible: "There is not, in my opinion, a more pleasing and triumphant consideration in religion than this, of the perpetual progress which the soul makes towards the perfection of its nature, without ever arriving at a period in it."

When however the stress of the voice and the significancy of the sentence rest on words of this kind, they are then not to be considered as mere circumstances, but as the capital figures, and ought, in propriety, to have the principal place allotted them. Thus the following sentence from Bolingbroke is correct: "In their prosperity my friends shall *never* hear of me; in their adversity, *always*."

VI. When either a resemblance or an opposition is intended to be expressed, some resemblance in the language and con-

struction should be preserved. When the things themselves correspond to each other, we naturally expect to find a similar correspondence in the words. Thus, when it is said: "The wise man is happy when he gains his own approbation; the fool, when he recommends himself to the applause of those about him," the opposition would have been more complete if it had been expressed thus; "The wise man is happy when he gains his own approbation; the fool, when he gains that of others." Again: "A friend exaggerates a man's virtues; an enemy inflames his crimes," would stand better thus: "A friend exaggerates a man's virtues; an enemy, his crimes."

The following passage from Pope's Preface to his Homer, fully exemplifies the observance of this rule: "Homer was the greater genius; Virgil, the better artist: in the one, we most admire the man; in the other, the work. Homer hurries us with a commanding impetuosity; Virgil leads us with an attractive majesty. Homer scatters with a generous profusion; Virgil bestows with a careful magnificence. Homer, like the Nile, pours out his riches with a sudden overflow; Virgil, like a river in its banks, with a constant stream." This regular and artificial mode of constructing sentences must not however be carried too far. If it be employed too often, it leads to a disagreeable uniformity, produces a regularly returning clink in the period, which tires the ear, and plainly discovers affectation.

II. ORNAMENT.

Literary compositions should be framed with a due regard not only to perspicuity, but also to elegance and harmony. A composition which is graced with beautiful language, constructed in harmonious periods, and set off by ornaments chosen with good taste and really illustrating the subject, finds its way to the mind of the reader much more readily than one which, however correct in itself, is clothed in dry and harsh language, and repels rather than attracts those to whom it is addressed.

Many of the rules we have already given in relation to perspicuity apply also to this part of the subject. As we have already observed, clearness is a positive beauty in itself. Purity, propriety, and precision in words, and clearness, unity, and strength in sentences, not only render a composition perspicuous; they tend very greatly to make it elegant and pleasing.

The rules which relate more immediately to ornament in style range themselves naturally under two heads: those which refer to:—

(1) The Use of the Figures of Speech.

(2) Harmony of Sentences.

We shall treat the first of these divisions of the subject in a separate chapter. The remarks which we make here relate to the second division.

HARMONY OF SENTENCES. Sound is a quality much inferior to sense, yet such as must not be disregarded. As long as sounds are the vehicle of our ideas, there will be a considerable connection between the idea which is conveyed and the nature of the sound which conveys it. Pleasing ideas and forcible reasoning can hardly be transmitted to the mind by means of harsh and disagreeable sounds.

In the Harmony of Periods the following points must be considered:—

(*a*) **The choice of words.** The ear alone is the correct guide. As a rule, words which are difficult to pronounce are, in the same proportion, harsh and painful to the ear. Vowels give softness, consonants strength, to the sound of words. The melody of language requires a due proportion of each. Long words are usually more agreeable than short ones.

Such words as the following are to be avoided:—(1) Such as are composed of words already compounded, as: *unsuccessfulness, wrongheadedness, tenderheartedness*. In these the several parts do not easily or closely unite. (2) Such as have the syllables which immediately follow the accented syllable crowded with consonants that do not easily coalesce, as: *questionless, chroniclers*. (3) Such as have too many syllables

following the accented syllable, as: *primarily*, *cursorily*, *summarily*, *peremptoriness*. (4) Such as have a short or unaccented syllable repeated or followed by another short or unaccented syllable very much resembling, as: *holily*, *sillily*, *farriery*.

(*b*) **The arrangement of words.** This is a point of greater nicety. For, let the words be chosen ever so well, yet, if they be ill disposed, the melody of the sentence is lost or impaired. The following is an example of a musical sentence from Milton: "We shall conduct you to a hill-side, laborious, indeed, at the first ascent; but else so smooth, so green, so full of goodly prospects and melodious sounds on every side, that the harp of Orpheus was not more charming." Everything here conspires to promote the harmony. The words are well chosen, and arranged with so much art that were we to alter the position of any one of them, we should mar the effect of the whole. We now give examples of sentences faulty in this respect: "Office or rank may be the recompense of intrigue, versatility, or flattery." "Pleasures simple and moderate always are the best." "A great recommendation of the guidance offered by integrity to us is, that it is by all men easily understood." These sentences would run better thus: "Rank or office may be the recompense of flattery, versatility, or intrigue." "Simple and moderate pleasures are always the best." "It is a great recommendation of the guidance offered to us by integrity, that it is easily understood by all men."

The various members of the sentence should be distributed in such a manner that it may glide easily along, without harshness or perplexity, and the whole should terminate in an agreeable cadence, or fall. The following is an example of a well modulated sentence from Addison: "It (sight) fills the mind with the largest variety of ideas; converses with its objects at the greatest distance; and continues the longest in action, without being tired or satiated with its proper enjoyments." On the other hand, another author, speaking of the Trinity, says: "It is a mystery which we firmly believe the truth of, and

humbly adore the depth of." How easily might this sentence be improved, thus: "It is a mystery, the truth of which we firmly believe, and the depth of which we humbly adore."

It may here be well to remark that the length and construction of sentences should be sufficiently varied. The ear tires of a number of sentences of similar construction following each other with monotonous regularity. Long and short sentences should be agreeably interspersed. Modern authors, as a rule, write shorter sentences than their predecessors. Lord Macaulay, in particular, often presents us with a long series of short, sharp sentences. Thus: "It was the depth of winter. The country was mountainous. The roads were impassable. The men were ill clothed. The horses were knocked up. The retreating army was far more numerous than the pursuing army. But difficulties and dangers vanished before the energy of Peterborough. He pushed on, driving Las Torres before him." This kind of writing is clear and vigorous, but it is wanting in harmony and dignity, especially when employed by writers inferior to Lord Macaulay, who was a master of style, and could venture on courses which his imitators would do well to avoid.

(*c*) **The sound should be adapted to the sense.** The writer should consider the kind of composition on which he is engaged, whether light or serious, narrative, declamatory, or conversational. Each kind should be written in that style of language which is best suited for it. The choice of words and the construction and modulation of the sentences should agree with the subject treated of. We may here again refer to the "Pilgrim's Progress" as a work written in the style suited to a simple subject. If a weighty historical work were composed in the same artless manner, the effect would be ridiculous. The simple style and familiar language used in Robinson Crusoe would be ill-adapted for such a work as "Locke's Essay on the Human Understanding."

FIGURES OF SPEECH.

Figurative language is employed by the best writers to embellish, illustrate, and lend a pleasing variety to the subjects on which they treat. The judicious use of figures of speech adds grace and beauty to an author's style, and often gives additional force and clearness to the ideas which he desires to convey to the reader.

Figures are used not only by writers; they are employed to a large extent in the ordinary conversation of the people. When we speak of a *smooth* tongue, a heart *inflamed* with anger, a *rough* manner, we do not use these words in their literal sense, but intend them to be understood with a figurative application to the objects which they describe.

Figurative language is better adapted to poetry than to prose. In prose writings it requires to be used with the greatest care and judgment; otherwise that which is intended to charm and enrich the composition only loads it with gaudy ornament. The plainest language is far preferable to that which is clothed with decorations not chosen with good taste. It is here that young authors are very liable to err. Their judgment not being corrected by experience, they are apt to think that everything which is very fine is very good; they mistake tinsel for gold, and only encumber the thoughts they intended to adorn. Lord Macaulay, in republishing his Essays, and explaining that they appear almost exactly as they were first written, speaks thus of the first of the series: "Even the criticism on Milton, which was written when the author was fresh from college, and which contains scarcely a paragraph such as his matured judgment approves, still remains overloaded with gaudy and ungraceful ornament."

A young writer showed his first literary effort, of which he was somewhat proud, to an eminent author, and asked him for the benefit of any criticism suggested by his great experience. The author thus referred to for counsel examined the essay, and said to the writer of it: "I would advise you to read your work

through very carefully, and whenever you come to any passage which you think very fine, to strike it out."

The principal figures used in composition are the following:—

(1) **Simile.** This is usually classed among figures of speech, but, properly speaking, it is not a figure at all. It merely compares one thing with another, or describes a resemblance in direct language. Thus:

"As the hart panteth after the water-brooks, so panteth my soul after Thee, O God."

"Like the leaves of the forest when summer is green,
That host with their banners at sunset were seen;
Like the leaves of the forest when autumn hath blown,
That host on the morrow lay withered and strown."

Byron.

"It droppeth as the gentle rain from heaven
Upon the place beneath."—*Shakspeare.*

(2) **Metaphor.** This is a figure which consists in attributing the signification of one person or thing to another. It is a similitude or comparison expressed in an abridged form, without the signs of comparison. If we say: "He is as cunning as a fox," we use a simile; but if we say, "He is an old fox," we then speak of him as actually being a fox, and the figure is called a metaphor. The following are additional examples:—

"Thy word is a lamp to my feet, and a light to my path."

"He lived, for life may long be borne
Ere *sorrow break its chain*."—*Mrs. Hemans.*

(Here *sorrow* is described as a prisoner *breaking his chain.*)

"The sentinel stars set their watch in the sky."—*Campbell.*

"I am the Good Shepherd."

Metaphor requires to be employed with great taste and judgment, or its effect is unhappy. The following rules have been given with reference to this figure:—

(*a*) Metaphors should be used with moderation and discretion: they should not be introduced profusely, nor should

their application be strained beyond due limits. The following passage is objectionable in this respect :—

"The bill underwent a great number of alterations and amendments, which were not effected without violent contest. At length, however, it was *floated* through both houses on the *tide* of a great majority, and *steered* into the *safe harbour* of royal approbation."

Here the author is so pleased with the metaphor which speaks of the bill as a ship, that he is unwilling to quit it.

(*b*) The resemblance on which the metaphor is founded should be clear, not far-fetched, forced, nor difficult to discover. Otherwise it will perplex the subject, instead of illustrating it.

(*c*) Metaphors and plain language should not be jumbled together, so that one part of an expression must be understood figuratively, the other literally. If this rule be transgressed, the passage becomes inconsistent with itself, and the sense confused. Pope, addressing the king, says :—

"To thee the world its present homage pays,
The harvest early, and mature the praise."

In the second line he uses the word *harvest* metaphorically in describing the *homage* of the world ; hence, to keep up the metaphor, he should not have employed the literal word *praise*, but *crop*. Here he was no doubt misled by the requirements of the rhyme.

(*d*) Two or more different metaphors should not be allowed to meet on one object ; otherwise we get *mixed metaphors*, which are ungraceful and confusing. Shakspeare's expression "to take arms against a sea of troubles" is faulty in this respect. We do not take *arms* against a *sea*. Addison writes:—

"I *bridle* in my struggling muse with pain,
That longs to *launch* into a bolder *strain*."

Here he first speaks of his muse as a horse (which must be bridled) ; then as a ship (which longs to *launch*). He then uses the literal word *strain*, and drops the metaphor altogether. The

same author, in the *Spectator*, says, "There is not a single view of human nature which is not sufficient to extinguish the seeds of pride." How can a *view* extinguish? and if it could do so, what sense is there in extinguishing seeds? Lord Macaulay points out a line faulty in this respect in the poems of Robert Montgomery:—

"One great *Enchanter helmed* the harmonious whole!"

An *enchanter* does not *helm*; and *helming* has nothing to do with *harmony*.

(3) **Allegory** is a metaphor continued through a long passage, or even through a whole book.

A fine example of allegory occurs in the 80th Psalm, where the Israelites are spoken of as a vine: "Thou hast brought a vine out of Egypt: Thou hast cast out the heathen, and planted it. Thou preparedst room for it, and didst cause it to take deep root, and it filled the land," etc.

Jesus Christ's parables are mostly allegories; so also is Bunyan's "Pilgrim's Progress," which represents the Christian as a pilgrim travelling on a long, difficult, and perilous journey.

Spenser's "Faerie Queene" is the finest allegorical poem in the English language.

The chief requisite about an allegory is, that it should be consistent throughout; that the figurative and literal meanings should not be mixed together, but be preserved everywhere distinct.

(4) **Metonomy** is a figure by which the cause is substituted for the effect, or the effect for the cause; the thing containing for that which it contains; the sign for that which it signifies.

Thus, if we say, "Have you read *Milton?*" we mean Milton's works: "the *kettle* boils," signifies "the *water* in the kettle boils." So also we speak of the "throne," or the "sceptre," meaning the "kingdom," as in the phrases, "He succeeded to the throne," "He assumed the sceptre."

(5) **Synecdoche** is a somewhat similar figure, by which a part is taken for the whole. "A fleet of twenty *sail*," is an instance, where the sail is taken for the whole ship. Similarly, we use

"head" for "person," and "waves" for "sea." A captain speaks of his sailors as "hands." A naval commander, sending home an account of a naval engagement, unconsciously made a curious use of this figure when he wrote, "One of our *hands* was shot through the *nose*."

(6) **Hyperbole** is a figure which produces an effect by means of *exaggeration*. A man who has become very thin is sometimes described as being "worn to a shadow." So again, a person is said to have "died with fright," when the meaning is simply, that he was very much frightened. There are several instances of hyperbole in the Bible. Thus, Abraham's seed was to become as numerous as "the sands on the sea shore." Other examples are found in John xxi. 25: "I suppose that even the world itself could not contain the books that should be written;" and Matt. xxiii. 24: "Ye blind guides, which strain at a gnat and swallow a camel."

The following line from Edgar Allen Poe furnishes a happy example of this figure. Speaking of the bells borne by the sledges, he says:—

"What a *world of merriment* their melody foretells!"

This figure requires to be employed with great judgment and moderation. If carried beyond the bounds of good taste, it becomes mere *bombast*, or *rant*, as in the following passage from Lee:—

"I found her on the floor
In all the storm of grief, yet beautiful;
Pouring forth tears at such a lavish rate
That were the world on fire, they might have drowned
The wrath of heaven, and quenched the mighty ruin."

(7) **Personification**, or **Prosopopœia**, is a figure which attributes life, feeling, and action to inanimate objects. It is often employed by the poets.

"There was a sound of revelry by night,
And Belgium's capital *had gathered* then
Her beauty and *her* chivalry."—*Byron.*

"Where smiling Spring its earliest visit paid,
And parting Summer's lingering blooms delayed."
Goldsmith.

Psalm cxiv. contains several examples of personification :—

"The sea saw it, and fled: Jordan was driven back. The mountains skipped like rams, and the little hills like lambs."

Personification is a kind of metaphor.

(8) **Apostrophe** is a turning aside from the direct course of the subject to address some person or thing.

This figure is allied to Personification, when it is used to address inanimate objects or abstract qualities. There are many examples of it in the Bible.

"O death, where is thy sting? O grave, where is thy victory?" —1 Cor. xv. 55. See also Isaiah xiv. 14–20.

The following are examples from the poets :—

"O Tiber! father Tiber,
To whom the Romans pray,
A Roman's life, a Roman's arms
Take thou in charge this day!"—*Macaulay.*

"Must we but weep o'er days more bless'd?
Must we but blush? Our fathers bled.
Earth! render back from out thy breast
A remnant of our Spartan dead!
Of the three hundred grant but three
To make a new Thermopylæ."—*Byron.*

(9) **Antithesis** is a figure which is founded on the contrast or opposition of objects or ideas. The following are examples :—

"If he had not been *a great fool*, he would not have been *a great writer*."—*Macaulay.*

"Though *deep*, yet *clear*; though *gentle*, yet not *dull*;
Strong without rage, without o'erflowing, full."—*Denham.*

"So true, so brave; *a lamb* at home,
A lion in the chase."—*Spencer.*

"Men have *done* brave deeds,
And bards have *sung* them well."—*Emerson.*

"For *men may come*, and men *may go*,
But *I go on for ever*."—*Tennyson.*

(10) **Climax** is a heightening of the thoughts or ideas contained in a sentence or passage, so as to produce a strong effect at the close. Thus Cæsar said: "I came, I saw, I conquered."

Another example is contained in the line from Byron:—

"And *nearer, clearer, deadlier* than before."

The following verse (taken in connection with the circumstances to which it refers) is an example of climax in narration. "Israel is fled before the Philistines, and there hath been also a great slaughter among the people, and thy two sons also, Hophni and Phinehas, are dead, and the ark of God is taken" (1 Sam. iv. 17). Here the character of the tidings gradually becomes more and more painful to Eli, till the last and most dreadful statement of all, that the ark of God was taken, so overwhelms him that "he fell from the seat backward, and his neck brake, and he died."

(11) **Anti-climax** is the converse of climax, and is used by satirical writers, to throw ridicule on some person or object. The following examples are from Pope, who is fond of this figure:—

"Not louder shrieks to pitying heaven are cast
When *husbands* or when *lap-dogs* breathe their last."

"Here thou, great Anna! whom three realms obey,
Dost sometimes *counsel* take—and sometimes *tea*."

(We may here observe, in passing, with reference to the rhyme in the last two lines, that at the time when Pope wrote, the word "tea" was pronounced "tay.")

PUNCTUATION.

Punctuation (Lat. *punctum*, a point) is the art of marking a written composition with certain points or stops, so as to divide it into clauses or members in such a way as to indicate the different pauses which are required by the sense.

In English, the marks employed in punctuation are properly four :—the Comma, the Semicolon, the Colon, and the Period, or Full Stop.

(1) **The Comma** (,) is the stop most frequently used, and represents a pause of the shortest duration. It is employed to separate those parts of a sentence which, though closely connected in sense and construction, yet require a pause between them.

The following are the principal rules for its proper use, or omission.

(*a*) It is generally wrong to separate the subject of a simple sentence from the predicate, even when the former is somewhat complicated, or consists of a substantive sentence. Thus :—

"'Better late than never' is a very old proverb."

"The fear of the Lord is the beginning of wisdom."

"But no artifice by which notoriety can be obtained is thought too abject for a man of letters."

"How soon faction again began to ferment is well known."

This rule is, however, not universally observed. Some good authors place a comma after a substantive sentence which forms a subject.

(*b*) A comma is employed before and after a sentence or phrase introduced in a parenthetical manner.

"Mr. Locke, I think, recommends the study of geometry."

"The knight, in order to follow so laudable an example, laid aside his helmet."

(*c*) Sometimes even a single word used parenthically is separated by commas from the rest of the sentence, in a similar manner.

"Few, however, are those who venture into that world of independent thought."

"I have resolved, sir, to attempt an assault."

(*d*) Noun phrases used in apposition are particular examples of parenthetical members which require a comma before and after them.

"Young Colonel Sidney, the celebrated Algernon, sat in the House this morning."

"Charles, second of the name, King of Spain, died.

(*e*) An adjective sentence, not inseparably connected with the antecedent of its relative pronoun, is preceded and followed by a comma. Here the adjective sentence is merely parenthetical.

"Shakspeare, who is horribly unjust to Joan of Arc, has put a sublime speech into her mouth."

"Poor Sophia, who now first heard of her little Tommy's fate, shed a shower of tears."

(*f*) If, however, the adjective sentence be closely connected with the antecedent of its relative pronoun, no comma should be used. The adjective sentence is then *necessary* to complete the sense.

"I lately met with two or three odd instances of that general respect which is shown to the good old Knight."

"In the poetical quarter, I found there were poets who had no monuments, and monuments which had no poets."

"The alarm which brings the blood in the swiftest current to a seaman's heart was now heard in the depths of the vessel."

(*g*) No comma should, as a rule, be used before a substantive sentence forming the object to another sentence.

"But we feel that we have already deferred too long the duty of paying some tribute to his memory."

(*h*) Two or more nouns in the same construction, two or more adjectives or participles belonging to the same noun, or two or more adverbs qualifying the same word or clause, are separated by commas. But when a pair of nouns, etc., is joined by the conjunctions "and" or "or," no comma is used.

"Books, paintings, music, horses, dogs, and sporting implements of all kinds, are at hand."

"John Bull is a plain, downright, matter-of-fact fellow."

"He was happy in being loved, esteemed, and respected."

"Success generally depends on acting prudently, steadily, and vigorously."

"Their valour and ferocity had made them conspicuous."

"We are fearfully and wonderfully made."

(*i*) Two or more verbs having the same nominative, and immediately following one another, are separated by commas.

If, however, the verbs are connected by a conjunction, the comma is omitted.

"In a letter, we may advise, exhort, comfort, request, and discuss."

"Examine, compare, choose, reject; but stand to your own judgment."

"The study of natural history expands and elevates the mind."

(*k*) Two co-ordinate sentences, when closely connected in meaning, are usually separated by a comma. Two sentences fully expressed, and introduced by co-relative conjunctions, are also generally separated by a comma.

"The shepherd in Virgil grew at last acquainted with Love, and found him a native of the rocks."

"Believe me for mine honour, and have respect to mine honour."

"As the hart panteth after the water-brooks, so panteth my soul after Thee, O God."

(*l*) Words contrasted with or opposed to each other are often separated by a comma.

"Though deep, yet clear; though gentle, yet not dull."

(*m*) Words used emphatically, or to address a person, are sometimes followed by a comma.

"He honoured his master; nay, he adored him."

"Well, upon my word, you have the finest children in the world."

"Why, did you not tell me that it was absolutely impossible for you to marry my daughter?"

"But, Sir John, one thing more."

Some of the above rules are liable to many exceptions, and must be used with judgment. Good authors differ much in the employment of the comma. Modern usage is in favour of its being dispensed with where the sense does not absolutely require a pause. It will be an instructive exercise for the pupil to compare the various ways in which it is used by different writers.

(2) **The Semicolon** (;) marks a somewhat longer pause than the comma ; it is used for dividing a complex or compound sentence into parts less closely connected than those which are separated by a comma.

The following are examples of the ways in which the semicolon is employed.

"My children, the offspring of temperance, as they were educated without softness, so they were at once well-formed and healthy ; my sons hardy and active, my daughters beautiful and blooming."

"They are larger and more clumsy than an ox ; they have short, thick, black horns close to their heads, which grow turning backwards."

"Trim came in front of his master, and made his bow ; my uncle Toby smoked on, and said no more."

"I was impatient to see it come upon table ; but, when it came, I could scarce eat a mouthful ; my tears choked me."

(3) **The Colon** (:) marks a still longer pause than the semicolon ; it divides a complex or compound sentence into parts less closely connected than those separated by semicolons, but not sufficiently independent of each other to form distinct sentences. It is used—

(*a*) When a sentence is complete as regards construction, but some supplemental remark or illustration is added to increase the force of what has already been stated.

"Trade is an extended and complicated consideration : it reaches as far as ships can sail or winds can blow."

"Do nothing in a passion : why wilt thou put to sea in the violence of a storm?"

(*b*) When one or more semicolons have preceded, and a still greater pause is necessary in order to mark a yet more distinct separation of the members of the sentence. These examples which follow will illustrate the use of the colon, semicolon, and comma, as employed in the same complete sentence.

"In less than another year we had another daughter, and now I was determined that Grissel should be her name; but a rich relation taking a fancy to stand godmother, the girl was by her directions called Sophia: so that we had two romantic names in the family; but I protest I had no hand in it."

"History is the ancient author: experience is the modern language. We form our taste on the first; we translate the sense and reason, we transfuse the spirit and force: but we imitate only the particular graces of the original; we imitate them according to the idiom of our own tongue, that is, we substitute often equivalents in the lieu of them, and are far from affecting to copy them servilely."

(*c*) To introduce a quotation, or a speech. "Unnion threw himself on the bleeding carcase, crying: 'Ah, Valentine! was it for me that thou hast died?'"

"They were in the habit of reading daily from that word where it is written: 'Owe no man anything.'"

(4) **The Period**, or **Full Stop** (.) marks the close of the whole sentence, whether simple, complex, or compound. Each complete sentence commences with a capital letter.

After a pause marked by a full stop an entirely new sentence commences, having a construction of its own, independent of that which precedes or follows.

"The session was now within ten days of its close. It was, therefore, impossible that any progress could be made in the trial till the next year. Hastings was admitted to bail; and further proceedings were postponed till the Houses should reassemble."

A Period is used after abbreviated forms of words; as, MS.; P.S.; A.D.; Mr.; Esq.; M P; i.e.; St. John; etc.

There are several other marks used in composition to in-

dicate either a pause of a more irregular kind, or a modulation of the voice required by the sense of the passage. Such are the following :—

(5) **The Dash** (—) properly used to indicate an abrupt pause, or sudden change in the construction of the sentence. This mark is sometimes employed by writers instead of the ordinary marks of punctuation simply to denote a pause in the sentence, but this practice is not to be recommended. The following are examples of its correct use :—

"The day we come to a place which we had long heard and read of—and in Italy we do so continually—it is an era of our lives."

"The body of Shelley is burned, but the remains are carried —whither?"

"She dreamed of a beautiful country—a land it seemed to her of rest—green shores, pleasant islands, and beautifully glittering water."

"At length—for it seemed long, measured by beating hearts, though scarce two minutes had elapsed—the ladder was fixed, an aerial bridge at a dizzy height, across the narrow street."

(6) **The Parenthesis** ( ) used to mark a break in the construction caused by a phrase being introduced by way of explanation or illustration. Its use is somewhat similar to that of the dash, but it indicates a rather less emphatic or abrupt interruption to the course of the sentence.

"It gave him (directly contrary to my intention) a very mean opinion of our understandings."

"Upon some account or other (I forget what) he was universally pitied by the whole regiment."

"I was compelled to live with him ; and (as was always the case in my dreams) for centuries."

There are several instances of the elegant use of the Parenthesis in Gray's Elegy, and Cowper's Lines to his Mother's Picture. (*See* "Pupil Teachers' Course," Year II.)

(7) **The Note of Interrogation** (?) used at the end of a sentence which asks a question (an interrogative sentence).

"Where is the dust that hath not been alive?"

"Well, my boy, what have you brought us from the fair?"

(8) **The Note of Exclamation** (!) placed after words, phrases, or sentences of an interjectional kind, expressive of any sudden emotion of joy, fear, surprise, etc. It is often employed after the name of a person who is called or addressed.

"'A gross of green spectacles!' repeated my wife, in a faint voice."

"'What!' cried my wife, 'not silver! the rims not silver!'"

"Ah! there was Karnak!"

"'Corporal!' said my uncle Toby."

There are several other marks or characters which are employed in written or printed composition. These are:—

(1) **The Apostrophe** (') used to mark an abbreviation of a word. Thus: *'tis*, for *it is; tho'*, for *though; e'er*, for *ever; belov'd*, for *beloved;* etc.

(2) **The Hyphen** (-) placed between the parts which make up a compound word. Thus: *bed-chamber, chimney-sweep, to-morrow, mother-in-law.*

It is also used at the end of a line, to show that a word is continued in the next line. When a word is thus divided, it should be done at the end of a syllable.

(3) **The Diæresis** (¨), or two points placed over one of two vowels which come together, in order to indicate that they belong to separate syllables. Thus: *aërial*, pronounced *a-erial.*

(4) **Inverted Commas** (" ") used to mark the beginning and end of a quotation or speech.

The student will find numerous examples of inverted commas in this chapter.

The following marks are also occasionally found:—

¶ to denote the beginning of a paragraph, particularly in the English Bible; an asterisk (*) to direct the reader's attention to a foot note; an obelisk (†) used in a similar manner.

PARAPHRASING.

The verb "paraphrase" is derived from the Greek words, *para* (beside, near), and *phrazo* (I say), and signifies properly to say the same thing in other words.

A paraphrase is an explanation of a passage of poetry or prose expressed in a clear and simple manner, so as to bring out the meaning of the author distinctly, forcibly, and completely.

A paraphrase resembles a translation so far as it is an expression of a given passage in other words. It differs from a translation by rendering the meaning of the passage in the language in which it was originally written.

The following remarks, with examples on English paraphrasing, may be useful to the student.

1. A paraphrase should be written in simple language, and express every idea contained in the original passage in the clearest possible manner.

2. A paraphrase should be written in good *modern* English, with due regard to a proper choice of words, elegance of style, and perspicuity of expression.

3. Any **inversions** contained in the original passage, should be reduced to their natural prose order. Thus: adjectives following nouns, nominatives coming after the verbs to which they form the subjects, prepositions placed after the objects they govern, should all be transferred to their proper positions. The following are examples:—"The last leave of thee takes my weeping eye" = "My weeping eye takes the last leave of thee."—*Shakspeare.* "Underneath this marble hearse lies the subject of all verse" = "The subject of all verse lies under this marble hearse."—*Jonson.* "His horse, who never in that sort had handled been before, what thing upon his back had got did wonder more and more" = "His horse, who had never been handled in that sort before, did wonder more and more what thing had got upon his back."—*Cowper.*

4. **Obscure expressions** should be explained. In many cases it will be necessary to *amplify* the passage, as the obscurity

often arises from extreme conciseness on the part of the author, especially in poetry. The student should, however, avoid being diffuse, employing no more words than are necessary. Other things being equal, the best paraphrase will be that which expresses the full meaning of the author in words most nearly approximating in number to those contained in the original passage. The following are instances of expressions which would require to be explained in a paraphrase :—"The winking of authority" = "The slightest sign or hint given by those in power."—*Shakspeare.* "Interlace not business but of necessity" = "Do not mix up one affair with another, if you can possibly avoid it."—*Bacon.* "Week in, week out" = "From the beginning of the week till the end of it."—*Longfellow.* *Pope* says : "What sin, to me unknown, dipped me in ink, my parents' or my own ;" meaning—"Was it my own sin or my parents' which caused me to take to writing, and so involved me in all the cares and worries of authorship." (For other examples see notes to Poetry and Prose in First, Second, Third, and Fourth Years.)

5. **Elliptical expressions** should generally be completed by supplying the missing words. Thus : "I must to Coventry" = I must *go* to Coventry."—*Shakspeare.* "Who lives by rule then, keeps good company" = "*He* who lives by rule then, keeps good company."—*Herbert.* "Full fifty years were passed and all forgot" = "Full fifty years were passed and all *was* forgot."—*Rogers.* "The grass which now beneath them, but above shall grow in its next verdure" = "The grass which now *grows* beneath them, but shall grow above *them* in its next verdure."—*Byron.*

6. **Obsolete words and meanings,** as well as grammatical inflections and constructions which have fallen out of use, should be rendered by their modern equivalents. Forms and usages of this kind will be frequently met with in our older writers, as Shakspeare, Spenser, Chaucer, etc. Many occur in the authorized translation of the Bible. The following are examples (*a*) From Shakspeare :—"More elder," for "elder";

"How much *more elder* art thou than thy looks." "Still," for "always"; The world is still deceived by ornament." "Little wots," for "little knows." (*b*) From Chaucer:—"Whilom," for "once, formerly." "Swiche," for such." "My peple me constreineth for to take another wif, and crien day by day; and eke the Pope rancour for to slake consenteth it" = My people urge me to take another wife, and cry out day after day; and also the Pope consents to it, in order to allay the public discontent." (*c*) From the Authorized Version:—"Divers," for "different." "Which," for "who"; "There was a certain householder, *which* planted a vineyard." "But as *touching* the resurrection of the dead" = "But *with regard to* the resurrection of the dead."

7. Poetical expressions should be reduced to simple prose equivalents. The force of metaphors or other figures of speech should be clearly brought out in plain, simple, and elegant language. Here it will frequently be necessary to amplify, since a complete picture will in poetry often be comprised in a single word. The following are examples of the poetical expressions alluded to under this head. *Shakspeare* speaks of "the silver rivers," that is, "the rivers filled with water shining in the sun and looking like silver." He alludes to the "*Sun* of Bolingbroke," meaning the *prosperity* of Bolingbroke, standing out full and brilliant like the sun in the firmament. Again, he says of Bolingbroke, "His treasons will sit blushing in his face," that is, "His treachery will be apparent to every one by the look of shame which will be seen on his countenance." *Byron* writes; "The mountains *look on* Marathon," that is, "The mountains *rise up* over Marathon, or form a lofty boundary to it." *Browning* says, "Up leaped of a sudden the sun," meaning simply "The sun rose suddenly." When *Macaulay*, referring to Horatius, writes: "And our good father Tiber bare bravely up his chin," he is only stating in poetical language, that "he succeeded in keeping his head above the water of the River Tiber."

8. At first sight it may appear easier to paraphrase prose than poetry. This is not the case, however. It is more difficult to

paraphrase prose than poetry, and the reasons for this are obvious after a little reflection. A passage written in prose is already in prose, the author has probably selected just those words and phrases which express his meaning best; and it is often difficult, or even impossible, to find others which can be substituted for the original ones without injuring the force and beauty of the author's work. Hence, in paraphrasing prose passages, it is sometimes necessary to adopt some of the words and phrases of the author without alteration. On the other hand, the style and modes of expression of poetry differ widely from those of prose, and therefore the ideas contained in a poetical passage admit more readily of being transferred to another and different kind of composition. It is often very difficult to find one prose expression to replace another prose expression with advantage, while it is easy to discover a prose expression which may be suitably employed instead of a poetical expression.

(9) In writing a prose paraphrase, a poetical style should be avoided. Metaphors and other figures of speech should, as a rule, not be used, as they are better adapted to poetry. If employed at all, they should be used sparingly, with good taste, in clear and simple language, and with a view to illustrating, rather than to embellishing, the subject treated of.

Before giving examples of paraphrasing, we add two short hints of a general kind, which we think may be useful to our young readers.

(*a*) Before *commencing* a paraphrase, examine the passage carefully throughout, and be quite sure that you thoroughly understand it. You cannot well convey, in words of your own, the meaning of a passage which you only imperfectly comprehend.

(*b*) Let your *main* object be, not so much to follow the *words* of the passage, with the object of merely substituting others to supply their places, as to grasp the *ideas* of the author, and then to express the meaning of them in your own language.

Examples of Paraphrasing.

(1) "Sweet was the sound, when oft at evening's close
Up yonder hill the village murmur rose;
There as I passed, with careless steps and slow,
The mingling notes came softened from below;
The swain, responsive as the milkmaid sung,
The sober herd that lowed to meet their young;
The noisy geese that gabbled o'er the pool,
The playful children just let loose from school;
The watchdog's voice that bayed the whispering wind,
And the loud laugh that spoke the vacant mind;
These all in sweet confusion sought the shade,
And filled each pause the nightingale had made."

Goldsmith.

Paraphrase.—It was pleasant when the evening came on to mount the neighbouring hill, and listen to the subdued tones which ascended from the village beneath. There, pacing to and fro, quietly and leisurely, I could hear the various sounds which, blended together, and subdued by distance, rose up from the plain. The voice of the ploughman answering to the song of the milkmaid, the lowing of the peaceful kine at the sight of their calves, the clamour of the geese that cackled in the pond, the shouts of merry children filled with joy on their release from school, the barking of the watch-dog at the rustling of the wind, the boisterous laugh which indicated a freedom from thought and cares: all these sounds, delightfully intermingled, arose in the evening twilight, and filled up the intervals between the songs of the nightingale.

(2) "It is worthy the observing, that there is no passion in the mind of man so weak, but it mates and masters the fear of death; and therefore death is no such terrible enemy when a man hath so many attendants about him that can win the combat of him. Revenge triumphs over death; love slights it; honour aspireth to it; grief flieth to it; fear preoccupateth it; nay, we read, after Otho the emperor had slain himself, pity

(which is the tenderest of affections) provoked many to die out of mere compassion to their sovereign, and as the truest sort of followers."—*Bacon's Essays.*

Paraphrase.—It deserves to be remarked that there is no passion of the human mind which is not strong enough to overpower and quell the fear of death,[1] which proves that death is not a very terrible foe after all, since men possess so many feelings which can overcome the apprehension of it. Men brave death in the pursuit of vengeance; love causes many to despise death; a feeling of honour often inspires others to seek it; the afflicted regard it as a refuge from their troubles; the timid rush into it through their terrors, and we even read that on the death of the Emperor Otho by his own hand, some were moved by pity (the slenderest[2] of human emotions) to put themselves to death from sympathy with their sovereign, thus proving themselves to be the most faithful of his subjects.[3]

(3) "Henry Bolingbroke
On both his knees doth kiss King Richard's hand;
And sends allegiance, and true faith of heart,
To his most royal person: hither come
Even at his feet to lay my arms and power;
Provided that, my banishment repealed,
And lands restored again, be freely granted:
If not, I'll use the vantage of my power,
And lay the summer's dust with showers of blood,
Rained from the wounds of slaughtered Englishmen:
The which, how far off from the mind of Bolingbroke
It is such crimson tempest should bedrench
The fresh green lap of fair King Richard's land,
My stooping duty tenderly shall show
Go, signify as much; while here we march
Upon the grassy carpet of this plain."

Shakspeare, Richard II.

[1] Or, "the dread of dying." [2] The word "tenderest" in the text means "softest," in the sense of "weakest, frailest." [3] Or, "adherents."

Paraphrase.—Go and deliver this message:—That I, Henry Bolingbroke, present my humble obeisance to King Richard, with the homage and sincere fidelity which are due from a subject to his sovereign dignity, and that I present myself before him in order to surrender into his hands my forces and authority; but only on condition that my sentence of banishment be annulled, and that I be replaced in full possession of my estates. Tell him, further, that, if this be not done, I intend to employ the strength I now wield in the prosecution of my rights, even though the land be watered with streams of blood flowing from the veins of Englishmen who fall in this quarrel; but that I am so unwilling that the pleasant fields of his kingdom should be thus stained with the blood of his subjects, that I am ready to come peacefully into his presence and make submission. Go and set forth these things, while our army marches up and down on these level green fields.

(4) "Certainly great persons had need to borrow other men's opinions to think themselves happy. For if they judge by their own feelings, they cannot find it; but if they think with themselves what other men think of them, and that other men would fain be as they are, then they are happy as it were by report, when, perhaps, they find the contrary within. For they are the first that find their own griefs, though they be the last that find their own faults. Certainly men in great fortunes are strangers to themselves, and while they are in the puzzle of business, they have no time to tend their health, either of body or mind."—*Bacon's Essays, XI.*

Paraphrase.—It is most assuredly necessary for men of high position to accept the judgments of others in order to deem themselves fortunate. Guided only by what they feel within themselves, they are unable to perceive their good fortune; but when they come to consider how other persons regard them, and that the latter would be very glad to occupy their position, then they enjoy a kind of reflected happiness, though their own feelings seem to tell them they are the reverse of happy. All men are the first to discover their own

troubles, though the last to be conscious of their own defects. Those of high station are unacquainted with themselves; the multiplicity of affairs which occupy their thoughts leaves them no leisure for attending to either soundness of mind or of body.

(5) "Thus to relieve the wretched, was his pride,
And e'en his failings leaned to virtue's side,
But in his duty prompt to every call,
He watched and wept, he prayed and felt, for all:
And as a bird each fond endearment tries
To tempt its new-fledged offspring to the skies,
He tried each art, reproved each dull delay,
Allured to brighter worlds, and led the way."

Goldsmith.

(*Given at Examination of Training Colleges, Females*, 1879.)

Paraphrase.—It was thus his highest aim to succour the miserable; and even when he erred, it was on the side of goodness. Always ready to discharge the obligations of his sacred office, he sat by the sick beds and entered into the sorrows of his parishioners, praying for and sympathizing with each of them. Like a parent bird which employs every loving artifice to entice its young ones to soar into the air on their newly-acquired wings, so did he put forth every effort, rebuking the careless and indifferent, to lead his people to heaven, while careful to show them the road by his own example.

(6) "Within the hollow crown
That rounds the mortal temples of a king,
Keeps Death his court; and there the antic sits,
Scoffing his state and grinning at his pomp,
Allowing him a breath, a little scene
To monarchize, be feared, and kill with looks,
Infusing him with self and vain conceit,
As if this flesh which walls about our life
Were brass impregnable; and humoured thus,
Comes at the last, and with a little pin
Bores through his castle wall, and farewell king!"

Shakspeare, Richard II.

Paraphrase.—I can imagine that I see Death enthroned like a merry monarch within the very diadem which encircles the brows of an earthly ruler, mocking at his splendour and jeering at his empty parade; permitting him for a short time to play the king, and fill his subjects with awe and reverence by his very aspect; inspiring him with vain admiration for himself and contempt for others, just as though he were surrounded with an impregnable barrier against the accidents of fortune; and after having sufficiently indulged his whims, coming at length, and with a slight exercise of his power breaking through his victim's defences and overturning his sovereignty for ever.

(7) "Lastly, near kinsfolk, and fellows in office, and those that are bred together, are more apt to envy their equals when they are raised. For it doth upbraid unto them their own fortunes, and pointeth at them, and cometh oftener into their remembrance, and incurreth likewise into the note of others; and envy ever redoubleth from speech and fame. Cain's envy was the more vile and malignant towards his brother Abel, because, when his sacrifice was better accepted, there was nobody to look on."—*Bacon's Essays, IX.*

Paraphrase.—In the last place, persons closely related by birth, those engaged together in similar occupations, and members of the same household, are more liable to be envious of their companions when the latter have attained a higher station in life. It seems a kind of reflection on their own want of success, a reproach directed at themselves personally; it is constantly obtruding itself on their own memory, and attracting the notice of others, so that here envy receives two great incentives from common talk and notoriety. Hence the envy of Cain at the preference shown to his brother's sacrifice was particularly base and malevolent, since he had not the provocation of being mortified by the preference shown to Abel's offering being observed by others.

(8) "Beside yon straggling fence that skirts the way
With blossomed furze unprofitably gay,—

There, in his noisy mansion skilled to rule,
The village master kept his little school;
A man severe he was, and stern to view;
I know him well, and every truant knew.
Well had the boding tremblers learned to trace
The day's disasters in his morning's face;
Full well they laughed with counterfeited glee
At all his jokes, for many a joke had he;
Full well the busy whisper circling round,
Conveyed the dismal tidings when he frowned."

Goldsmith.

Paraphrase.—At the side of that irregular hedge which borders the road, and adorns it with its gaudy but useless furze blossoms, there stood formerly the house in which the village schoolmaster used to display his skill in managing his small but boisterous establishment. He was a man strict in discipline, and of austere aspect; I was well acquainted with him, and so was every lad who defied his authority by playing truant. His anxious pupils had learned by experience to foretell from the appearance of his face in the morning whether the day would be passed pleasantly or otherwise; many a time did they force themselves to smile at his jests, which were very numerous, and frequently enough did they tremble when the news passed round quietly from pupil to pupil that he was in an ill humour.

For other specimens of paraphrasing, see "Papers for Teachers." Pupil teachers should be exercised in writing paraphrases from good authors. Any school reading-book will supply passages. The exercises for parsing and analysis may also be employed for this purpose.

PUPIL TEACHERS' EXAMINATIONS.

We here offer to pupil teachers a few hints of a general kind on the manner in which questions should be answered at their examinations. Some of these are repeated from our book for the Second Year.

1. First of all, read the directions given on the Examination Paper.

2. Be careful to fill in correctly the particulars as to name, age, school, etc., which are asked for at the head of each paper, *before commencing your answers.*

3. Select the questions which you can answer *best*, and answer those *first.*

4. Carefully consider the exact meaning and scope of each question before *commencing* to answer it.

5. Do not let your answers contain *more* than is asked for.

6. On the other hand, do not omit from your answers anything that *is* asked for.

7. If you should be in any doubt as to the exact extent of the matter required from you, you had better err on the right side by giving too much, than on the wrong side by giving too little.

8. Answer as many questions as you can, as far as time and the regulations of the examination will allow. Sometimes a question is divided into two or more heads; if you can only answer a part of the whole question, do so.

9. As far as possible, write your answers at once on the examination paper. Do not waste time in first making a rough draft of your answers, and then copying them out fairly.

10. Avoid the use of too many words (*diffuseness*).

11. On the other hand, use words enough to express your meaning fully and intelligibly. Do not let there be the slightest difficulty in understanding every part of your answers.

12. Use short sentences, and avoid the use of long or uncommon words.

13. Pay attention to the *form* of your answers. When a subject admits of being arranged neatly under heads, an answer should be drawn up in divisions and subdivisions. These should be disposed in their natural order, each forming a distinct part of the whole subject.

14. Carefully examine your work afterwards, and avoid the admission of errors in matters of *fact* or *calculation.*

NOTES OF LESSONS.

REMARKS on the Composition of Notes of Lessons are given in the "Pupil Teachers' Course," Third Year. We now present a list of subjects for Notes of Lessons given in Examination Papers, together with some further specimens of the manner in which they should be drawn up.

(1) Write Notes of a Lesson on Cleanliness.

1. **Its necessity.** Show that matter is continually collecting on the surface of bodies; on our tables, chairs, mantel-pieces, floors, etc. This has to be cleaned off now and then, or the bodies in question would become so begrimed with dirt as to be quite disfigured. So the human body requires to be cleansed, or it becomes unfit to be seen. Point out the vast difference in appearance between a dirty face and a clean face, between dirty hands and clean hands.

Show that cleanliness is conducive to health. The skin is perforated with little pores (or holes) which become stopped up by perspiration and small particles of dirt which collect on the surface of the body, and require to be removed, otherwise they prevent the circulation of air in the human system.

Refer to fevers and pestilences, which are caused by a want of cleanliness. In times of epidemical diseases, dirty towns suffer more than clean ones, and disorders of this kind ravage more especially the filthy portions of the districts in which they occur.

2. **Its desirability.**

(*a*) Every one dislikes an unclean person. No one likes to sit by a dirty boy, play with him in the playground, or walk with him in the streets. The boy who sits next him in the class gets as far away from him as possible, and shuns his company when school is over.

(*b*) The dirty boy sets a bad example to others. He is generally an idle fellow, as lazy over his lessons as careless in his person, and a source of mischief, by setting a bad example.

(*c*) The dirty boy is a disgrace to his schoolfellows. He

lowers the character of the school and family to which he belongs.

(*d*) He who is uncleanly is wanting in respect to others. A boy who goes to school, or to work, should remember that he is associating with other lads, and with his teachers, and that they can well feel themselves treated with disrespect if he seems to consider that he may appear before them in any state whatever.

3. **What it consists in.**

(*a*) Cleanliness of person. Hands and face should be washed frequently, teeth should be cleansed, and dirt removed from the nails. The whole body should be washed every morning if possible, and a cold bath taken frequently, both in summer and winter.

(*b*) Cleanliness of dress. With children this will depend much on the parents; but show how boys and girls can themselves do a great deal to keep their clothes clean. They should get into the dirt as little as possible, and by keeping their persons clean they will be helping to keep their clothes clean. Then they can brush their clothes and clean their boots; and their parents, if they see that they are anxious to be clean themselves, will take a pleasure in doing all they can to help them. Elder girls can assist greatly in keeping their younger brothers and sisters clean.

(*c*) Cleanliness in dwellings. Show how important this is. A dirty house is uncomfortable, liable to disease, and injurious to the other two forms of cleanliness, viz., of person and of dress. The floors should be scrubbed, the walls and yard swept, the hearths kept tidy, and everything removed which is likely to create annoyance and discomfort to the inmates. When the father comes home in the evening from his work, he should see everything looking bright, clean, and comfortable. Show how children can co-operate with their mother in producing this effect; the boys can be careful not to bring any more dirt into the house than they can help; they can scrape and rub their feet on the mat when they enter; they can polish the fire-irons

and other utensils, and sweep up the yard. The girls can assist their mother in almost all the household duties. Both boys and girls can set a good example to their younger brothers and sisters.

4. **Means of cleanliness.** These have mostly been already given, and the children should now be called upon to name the various *operations* connected with cleanliness; as, washing, scrubbing, bathing, combing the hair, etc. Then call for the names of *materials* used in these operations; as, water, soap, soda, etc. Lastly, the names of *instruments*, etc., used for purposes of cleanliness should be asked for; as, the comb, brushes of various descriptions, door-mat, scraper, etc.

Use a blackboard throughout the lesson for writing down the heads, and recapitulate at the close.

(2) Give a sketch of a lesson which you have heard given by the teacher of your school, and draw up a series of questions which you might have put to your class to see whether they had attended to the lesson.

(3) Write notes of a lesson on "Practice" to a class just beginning to learn that arithmetical method.

(4) Write notes of a first lesson on The Verb.

(5) Write notes of a lesson on Kindness to Animals.

(6) Write full notes of a lesson on a Balloon.

1. **The principle of the balloon.**

Show that a body rises in a fluid which is heavier than itself, and sinks in a fluid which is lighter than itself. If we place a cork in a vessel of water, what happens? It rises to the surface. If we place a piece of lead in water, what happens? It sinks to the bottom. The lead is drawn to the earth (by gravity) more powerfully than the water, hence the particles of water are forced aside, and the lead falls. Similarly the cork ascends.

We live at the bottom of a fluid called air, which extends for many miles above the earth. Any bodies which are lighter than the air will rise in it, as the cork does in the water. Illustrate by smoke rising in the air; by a feather; by a piece of light paper.

Illustrate also by the clouds floating high in the air. Do the clouds lie on the upper surface of the air? No. Why not? The air becomes rarer as the distance from the earth increases. The lower portion of the atmosphere is much denser than the upper, because it is pressed together by the air above it. Illustrate by a haystack, in which the hay at the bottom is pressed together by that which lies above it. How high, then, do the clouds ascend? Till they arrive at air which is as light as themselves. (Use the term *specific gravity*, if the children are acquainted with it.)

If, then, we get a bag, and fill it with smoke, or with some substance lighter than the air, what will happen? The bag will ascend.

2. **The construction of the balloon.**

(1) The fire-balloon. (The children will probably be well acquainted with this kind of balloon; perhaps they have had one or two sent up in their presence at their last school treat. Any circumstance of this kind should be taken due advantage of.) A bag of light paper is filled with smoke and hot air (which is lighter than cold air). A sponge dipped in turpentine is set on fire at the mouth of the balloon, and the whole ascends by reason of the whole being lighter than the air. Explain why the lighted sponge is placed at the mouth of the balloon; to keep the air inside heated, and so maintain the lightness and buoyancy of the balloon.

(2) The air-balloon. Made of silk. Why? Because it is both light and strong. Filled with hydrogen gas, the lightest substance known, or with coal-gas. Covered with a net-work, from which the car is suspended. The car is generally made of basket or wicker-work. Why? Because it is light and strong. (Exhibit a picture of the balloon.) Show that the lightness of the gas inside the balloon will cause the latter to ascend, with the car and its contents, till it arrives at a stratum of air of the same density as the balloon and its appendages. Explain the use of the sand, or *ballast*, carried in the car. The men in the car can regulate the height to which they rise by

throwing out less or more of the ballast. Show how they descend. By letting the gas escape through a valve. Explain the use of the *grappling-irons* in descending. To catch some tree or object on the earth, like sailors use an anchor at sea to prevent themselves being driven along by the wind.

By means of the balloon men have risen several miles into the air. If there be time, some famous ascents, by Mr. Glaisher and others, might be described. Give the term "aeronaut," Gr. *nautes*, a sailor.

3. **Uses of the balloon.**

(1) Fire-balloon, for amusement.

(2) Air-balloon, to gratify a natural desire for rising into the air like the birds. Who has not longed to soar into the sky like the lark?

(3) To make scientific observations. Barometers, thermometers, and other scientific instruments are carried up in the car, and observations are made with respect to temperature, atmospheric pressure, clouds, etc. Much valuable knowledge has thus been gained.

(4) To make general observations, especially in time of war. Of late years military men have ascended in balloons to observe the disposition of the hostile forces.

(5) Many think it probable that the balloon will be used for purposes of locomotion. The difficulty is to guide or *navigate* the balloon, since it is obliged to travel with the wind. Great hopes are entertained by competent authorities that the North Pole may be reached by means of the balloon.

(7) Write notes of a lesson on the Sense of Sight.

(8) Write full notes of a lesson on some useful Trade.

(9) Write full notes of a lesson on some Battle in English History.

(10) Write full notes of a lesson on Multiplication of Money.

(11) Write notes of a first lesson to be given to infants on a Map.

Use a blackboard and a map of England.

Where are we now? In the schoolroom. What lies on this

side of the school? (Point to the west wall.) The street What lies on the opposite side? (Point to the east wall.) The playground. What lies beyond the playground? The railway. And beyond the railway? The fields. And beyond the fields? A brook. (Let the names of the places be given in each instance.)

Draw an oblong for the schoolroom on the blackboard. Now where must I place the playground? Where did the sun begin his journey this morning? Did any one see him early this morning? (Probably some one of the children saw the sun early that morning, and can describe his position; if not, they must be told.) Where was he then? Does the sun rise there *every* morning? What is that direction called? The east. Then the playground is to the *east* of the schoolroom. We will place the playground on the right hand of the schoolroom, to show that it is on the east of the schoolroom. So if we place anything else to the right hand of the schoolroom, that is to show that it lies to the east of the schoolroom. Must we place the street on the same side of the schoolroom as the playground? No, on the opposite side. What is that side called? The left hand. Give the term *west*. That is where the sun sinks down, or sets, in the evening. So the right-hand side is the east, and the left-hand is the west. How do we mark the street? Draw a long line, because the street is long and narrow.

Next draw a line for the railway, and show that it must be on the right-hand side of the playground. Then mark the fields and the brook beyond it.

Point to the south wall of the schoolroom. What lies in that direction? The church. Where shall we place the church on the blackboard? Where do you see the sun when you leave school at twelve o'clock? Over the church. That is the *south*. We must let the lower part of the blackboard be the south; because, if we look towards the east, we have the south on our right hand. A few questions will bring this out clearly to the children. Then we place the church *below* the schoolroom on the black board to show that it is on the south of the schoolroom.

Next point to the north wall. What lies in that direction? A meadow. Where do we place the meadow on the blackboard? Opposite the church. Give the term *north*, opposite the south, and towards the top of the blackboard. Then the north lies towards the top of the blackboard, the south towards the bottom, the east towards the right hand, and the west towards the left hand. Now we have a *map* of the places round the school.

Now show the children the map of England. We have a great many places here. What is the name of the place we live in? ——. [The names are left blank; the teacher can fill them in to suit the locality where the lesson is given.] Here it is on the map, where you see the round dot. Did you ever hear of another place not far off? Yes, ——. (Take the names of places, choose the most convenient for the purpose of illustration.) Here it is on the map. You see it lies above the other one. What does that mean? It lies to the north. Did any of you ever go there? Yes. Did you remember crossing anything? Yes, a bridge, with a stream of water running under it. (Get the name, if possible.) Here it is on the map, like a long black line; that means a river. You see it lies between —— and ——.

What do we walk on? The ground, land. What do we see all round us? Land. Is there land everywhere? Look at the map. We see that in the part where we live the map is coloured; that means land. Now if we go a long way down the map towards the south, we come to an uncoloured part, with no dots for towns. What does that mean? Water. Look round the map. We see water to the east, south, and west. England has water to the east, south, and west. So, if we went a good many miles east, south, or west, we should get to the end of the land, and come to where there is nothing but water, just as where we are now there is nothing but land.

(12) Write full notes of a lesson on Moods of Verbs.

Note.—The following is taken from "Moffatt's Scholarship Answers, Midsummer, 1879." It exhibits a form of notes of lessons which may often be found convenient.

Points.	*Explanation.*	*Blackboard.*
Examples of the various moods.	(*a*) Write on B.B. such a sentence as "John runs." Elicit or point out that the verb "runs" is here used to make a statement about John. It *indicates*, or points out, what John *actually* does.	John runs.
	(*b*) Write on B.B. the sentence "Run, John, run!" and elicit that the same verb is here used in a *different form*, to express *command*.	Run, John, run!
	(*c*) Write on B.B. the sentence "John can run," and elicit that the verb is here used in another form to express John's *power* of running.	John can run.
	(*d*) Write on B.B. the sentence "If John run, he will fall," and point out that the verb in this form expresses, not what John actually does, but what he might do.	If John run, he will fall.
	(*e*) Lastly, write on B.B. "To run," and elicit that this form of the verb refers neither to time, nor number, nor person.	To run.
Generalisation.	Now point out that the verb varies in form according to the manner or *mode* in which the action is related to the thing spoken of; and tell the children that these variations of form are called modes or MOODS of the verb.	MOODS.
Names of the moods.	(*a*) Take the first sentence again —"John runs;" ask children what the verb does, and tell them that	*Indicative.* John runs.

Points.	*Explanation.*	*Blackboard.*
	because it *indicates* or points out what John actually does, it is said to be in the *Indicative Mood.*	
	(*b*) Ask children what the verb expresses in the second sentence, "Run, John, run;" and tell them that because it expresses a command, it is said to be in the *Imperative Mood* (*imperare*, to command).	*Imperative.* Run, John, run.
	(*c*) Ask children what the verb expresses in the third sentence, "John can run;" and tell them that because it expresses power, it is said to be in the *Potential Mood* (*potentia*, power).	*Potential.* John can run.
	(*d*) Ask children what the verb expresses in the fourth sentence, "If John run;" and tell them that here it is said to be in the *Subjunctive Mood.*	*Subjunctive.* If John run.
	(*e*) Tell children that "To run" is said to be in the *Infinitive Mood*, because its meaning is *not limited* as to time, or number, or person (*infinitus*, unlimited).	*Infinitive.* To run.
Exercises.	Write on B.B. a number of sentences, and let children pick out verbs, and say what moods they are in.	

(13) Write full notes of a lesson on the Changes of the Seasons.

(14) Write full notes of a lesson on the Processes of some Manufacture.

(15) Write full notes of a lesson on Post-office orders.

(16) Write notes of a lesson on the Moon.

(17) Write notes of a lesson on Air.

(18) Write full notes of a lesson on a Coal mine.

EXERCISES IN COMPOSITION.

The following are exercises in Composition selected from Fourth (or Fifth) Year Examination Papers.

(1) Write an Essay on Poetry.

Note. A very long essay might be written on this subject. The following is such a one as would be suitable for an examination paper:—

Of the two kinds of literary composition, poetry and prose, the former is the more delightful. Prose is better fitted for historical works, religious and moral essays, books containing narratives of facts, accounts of scientific investigations, and other similar matters. Poetry is more suitable for works in which the imagination or fancy of the writer is called into action. The truth should, of course, not be sacrificed; but the poet is permitted to use fiction to a large extent in illustrating his thoughts. The prose writer employs a sober and matter-of-fact kind of style; the poet uses figures, and embellishes his subject by ornaments, which should be elegant, chosen with good taste, and suitable to the matter in hand.

Metre and rhyme are employed in poetical compositions, but they are not in themselves sufficient to constitute *poetry*. The thoughts, the language, the whole air of the composition should breathe a poetical spirit, or else it is not real poetry. If we compare the dry, straightforward accounts which the old chroniclers gave of the history of England, with the splendid historical plays of Shakspeare, which are founded on them, we see at once that the difference in effect is not merely that the

poet has employed metre. For the purposes of mere literal historical truth, the chroniclers are to be preferred; but in reading the plays we feel that the poet not only relates events, but fills the imagination and elevates the soul.

Poetry has been employed by great writers in many kinds of composition. Poems narrating great historical events in a complete manner and in a lofty style, are called Epic poems. The Iliad of Homer and the Æneid of Virgil are famous examples of this kind of poem. Dramatic poems are those which are written in the form of dialogues between characters who appear on the stage and carry on the action of the dramas. The Greeks brought this kind of composition to great perfection. Their great dramatists, Æschylus and Sophocles, have, however, been surpassed by our great poet, Shakspeare. A Didactic poem is one which is of an *instructive* nature, as the Georgics of Virgil, which treat of agriculture. An Elegy is a poem expressive of lamentation on the death of some person, as Gray's "Elegy," and Tennyson's "In Memoriam." Lyric poetry is written in the form of odes, supposed properly to be set to music. Dryden's "Alexander's Feast," and Collins' "Ode to the Passions," are examples.

English literature is especially rich in poetry. Our greatest poet, Shakspeare, has already been mentioned. Milton's "Paradise Lost" is a religious epic poem of great beauty. Spenser's "Faerie Queene," is a splendid poem, illustrating the age of chivalry. Chaucer's Tales are among the finest in existence. The poems of Dryden and Pope are famous for their admirable versification. Cowper is a great religious poet. Wordsworth's poems are some of the best written in the present century. Alfred Tennyson and Robert Browning are our greatest living writers of poetry.

(2) Write an Essay on a Parliamentary Election.

In a free country like England, the people have a large share in making the laws which they are required to obey. They are not ruled entirely by persons set over them without their own consent, but possess the right of self-government, which com-

prises the power of forming the laws, appointing those who are to administer them, and controlling the levying and expenditure of the public revenues.

The most natural and complete form of self-government would be for all the citizens of a country to meet together in order to make laws and administer the affairs of the country. This mode of conducting public business is, however, manifestly impossible in a nation which numbers some millions. Hence the principle of *representation* is adopted, by which the people in the various parts of the country choose deputies to act as their substitutes in the National Assembly, which in England is called the Parliament. The process of selecting members of the British Parliament is called a Parliamentary Election, from the Latin word *eligo* (*electus*), I choose. Members of Parliament are chosen by certain towns, called *boroughs*, and by the different counties. Most householders who live in boroughs, and pay the rates, have a vote; in the rural districts the privilege is somewhat more restricted.

The Parliamentary Election which took place in the British Islands in 1880 was a General Election, since it was caused by a Dissolution of Parliament, and was therefore held throughout the United Kingdom. No Parliament can continue in existence longer than seven years, and very few last so long as that. Most of them come to an end before the expiration of that period. Sometimes an election takes place only in some particular borough or county, in order to fill up the place of a member who has been removed by death, resignation, or other cause.

The Members of Parliament selected by the people sit in the House of Commons. England is represented by 493 members, Scotland by 60, and Ireland by 105, making a total of 658.

A parliamentary election is a matter of great public importance, since the House of Commons is by far the most powerful branch of the Legislature. It has the command of the national revenues; and since the Prime Minister, who acts for the Sovereign, is by constitutional usage obliged to command a

majority in the House of Commons, the latter has really the power of controlling the whole policy of the Government. Hence it is very desirable that electors should exercise their privileges under a feeling of great responsibility. They should carefully study the affairs of the nation, understand the principles of the two great political parties, acquaint themselves with the views of the leading statesmen on both sides, and especially learn as accurately as possible the opinions of those who offer themselves for election at their hands. When called upon to exercise his right of choice between two or more candidates, the elector should ask himself the question, Which among them is the most suitable to assist in the government of the country and of the whole empire?

Great care is taken to protect the elector in exercising his electoral rights without fear or favour. Formerly much bribery and intimidation were used to induce persons to vote in a manner not in accordance with their own wishes. To prevent these abuses, voting now takes place by *ballot;* that is, votes are given in secret, and no one but the elector himself has the opportunity of seeing how his vote has been given.

(3) Write an essay on the English Monarchy.

(4) Write an essay comparing Town and Country Schools.

(5) Write an essay on "Home Lessons," how to plan and examine them.

(6) Write an essay on Economy of Food.

(7) Write an essay on Newspapers.

(8) Write a short essay on Fresh Air and its Uses.

(9) Write a short essay on Instinct in Animals.

(10) Write a short essay on the Uses of Grammar.

(11) Write out a short essay on Christmas.

(12) Explain what is the difference between giving a lesson to a class and giving a lecture to one, and why a lecture is easier to give than a lesson.

(13) Relate the advantages of early rising.

Note.—We here point out a few heads that might be taken.

(*a*) Benefit to health; (*b*) Gain of time; (*c*) Morning the best

time to study, because then (i.) the mind is fresh, (ii.) everything is quiet. (*d*) Morning the best time to enjoy the beauties of nature; when the sun is rising, the birds are singing their morning song, and the dew is sparkling on the grass, etc.

(14) Explain what you consider *good style* in writing.

(15) Describe, as to a first class, the Railway System of England.

Note.—Show how the railways converge to the Metropolis. Three great roads run to the north and join the Scotch lines; the North Western, the Midland, and the Great Northern (continued by the North Eastern). The North Western throws out a great branch along North Wales towards Ireland. The Great Western runs to the west and south-west into South Wales and Cornwall. The South Western to the south-west into Dorsetshire and Devonshire. The Great Eastern connects the eastern counties with London. The South Eastern and London Chatham and Dover connect Kent and Sussex with the Metropolis. The London Brighton and South Coast connects London with the southern counties.

(16) Write out an account of any naval engagement, campaign, machine, picture gallery, or exhibition of any kind which you have read about or seen.

(17) "Long before we saw the sea its spray was on our lips and showered salt rain upon us the tremendous sea itself when I could find sufficient pause to look at it in the agitation of the blinding wind the flying stones and sand and the awful noise confounded me as the high watery walls came rolling in and tumbled into surf they looked as if the least would engulf the town."

Copy out the above passage with proper punctuation marks; explain, as to a class, the meaning of the whole passage, and of any difficult words; and correct mistakes which children might make in *pronunciation*, *emphasis*, or *pause*.

(18) Describe fully the manner in which you would give a lesson in *dictation*, and say what means you would adopt to prevent copying and to correct errors.

(19) Write a short description of the county in which your school is situated.

(20) Write a letter to a friend, giving a short account of your late holidays.

(21) Answer at length the following question :—If you disregard the speed at which passengers and goods are carried from place to place by railways, are there any advantages over the old fashion of travelling by road in the modern one of travelling by steam?

(22) Write out an account of the chief employments of the working class in the town or village in which your school is situated.

(23) Write an account of any poem which you have partly repeated during your apprenticeship.

(24) Write an essay on Money.

(25) Write an essay on The House of Lords.

For other specimens of Notes of Lessons and Essays, see *Papers for Teachers and Students.* This monthly periodical also contains solutions of mathematical problems, answers to examination questions, Pupil Teacher Examination Papers, lessons in Latin and French, and articles on various subjects interesting to teachers and students. It is well fitted to be used as supplementary to "The Pupil Teachers' Course."

MUSIC.

Introduction.

(*a*) Reflections by the way.

(*b*) Résumé of third year's course.

(*a*) **Reflections by the way.** A man enjoys a master-painting none the less, but rather all the more, for being acquainted with the peculiar technicalities of the art which has produced it. A familiarity with the difficulties in the way of pictorial representation will enable him the more thoroughly to estimate and appreciate the triumph before him. Certainly his admiration will not be arrested by the probably gaudy frame or other surroundings, but will dive deep into beauties which even the practised eye takes time to discover. Nor will he be dazzled, as a child might be, by tricks of colour and brilliancy of tint, but will seek subtler evidence of genius. Similarly, who will be so alive to the excellences of some magnificent and stately pile as the architect thoroughly grounded in the principles and an adept in the practices of his art? who so affected by the majesty of the choruses in the "Messiah" as blind old Handel himself; or so overpowered by the harmony which he had himself created as the aged Haydn when in the concert-house of Vienna, with upraised arms and tearful eyes, he cried, "Not from me, but thence does all this come"?

There are technicalities more or less troublesome lying at the threshold of every enterprise or career. The arts have theirs, formulated by previous workers as stepping-stones for their successors; and they who, by the force of genius, have climbed to the higher platforms whence larger truths and grander beauties have been perceivable, must be the guides to direct our steps,

the sages at whose feet we must learn what we are to know. In our turn we strive and stumble, perhaps painfully, through the thorny ways of first technicalities, only to learn the delight of following our leaders and to enjoy the fruits of their labours.

Of necessity this present course of lessons is very elementary; but we have in it endeavoured to deal with preliminary technicalities in such a way as to arouse the intelligent interest of the student, and as far as possible to suggest to him those broader considerations which discover how mutually interdependent are all facts and phenomena, and that however distinct for our own purposes we may classify this and that set of facts, yet are they but various manifestations of an all-pervading truth.

The student at the best has only learned his A B C and become vaguely conscious of higher possibilities. He will do well to endeavour to realize those possibilities. He must from his alphabet proceed to his grammar of harmony, must put himself in the way of becoming familiar with the writings of good composers, must try himself to interpret by voice and instrument such pieces as lie within his skill. He will not tire if he be not a mechanical musician. He must not be a mechanical musician, or he will tire, as any other purely mechanical, perfunctory being must. He will court the strains that appeal to his heart, his imagination, his faith, and which lend themselves to sweeten, deepen, and intensify all the emotions.

If he is by-and-by able to disport himself so far, his revels will be in a region enjoyed by many, understood by none. "*Why*" the soul links its finest and most subtle faculties to vibrations of matter is, and probably ever will be, as much a mystery as chlorophyll and the hues of the flowers. Though this solution may be impossible to us, there nevertheless remain a number of investigations which the growth of the art will bring about, and which will enrich the music of the future. Somewhat in this direction are the remarks of the Rev. H. R. Haweis, author of "Music and Morals," who in one of his fugitive papers says, "The musical criticisms of the day deal chiefly in technicality and personality, and it is unfortunate that the few writers who

occasionally venture out into the deep, and discourse on music *per se*, are deficient in the one thing needful, 'musical perception.' . . . Music has its morals, its right and wrong, its high and low, like any other art; and until people can be got to understand how this can be, and why it must be, music will never assert its dignity among the arts and receive its dues. Before Mr. Ruskin wrote, people thought that there was no right or wrong about painting, sculpture, and architecture; and musical criticism has been in the same slough of despond. And what is the consequence? Painting and sculpture rank above music; and yet music, not painting and sculpture, is *the* modern art. Yet no one has been found to do for the new art of music what Mr. Ruskin has done for painting and architecture—to create for it a moral philosophy as well as a rationale."

(*b*) **Résumé of third year's course.**

(1) Of the scales which formerly existed, two only remain in common use; viz., those of Do and La.

(2) These two scales differ from each other in their third, sixth, and seventh intervals, but are elsewhere similar. The third, sixth, and seventh of the Do scale are major, but in the La scale are minor.

(3) It is the minor third that has most to do in giving the peculiar effect to the La scale.

(4) A major scale is one whose third from its tonic is major; a minor scale is one whose third from its tonic is minor.

(5) The Do and La scales are said to be related to each other, so that the tonic of a relative minor is always the minor third below the tonic of the major.

(6) The first form of the minor scale was simply that of La; but the upper tetrachord, having no leading note, came to be altered.

(7) This alteration provided a leading note by sharpening the Sol, and further, to avoid the occurrence of a second greater than a diatonic tone sharpened the Fa.

(8) Thus the upper tetrachord became identical with that of the major, and lost its minor character.

(9) As the necessity for a leading note is felt rather in ascending than in descending, the sixth and seventh were sharpened in the ascending, but allowed to resume their first form in the descending movement.

(10) Minors have the same key signature as their relative majors, but require the occasional use of accidentals to sharpen the sixth and seventh.

(11) A minor of the same base as a major, or in other words a tonic minor, has a totally different signature. For example, A minor is open, while A major has three sharps. E minor has one sharp, but E major has four. F minor has four flats, but F major has but one, and so on.

The Chromatic Minor Scale and the Chromatic Intervals found in it. It has been said that language makes grammar, and not grammar language. That is to say, dry grammatical rules were not first invented, and then adopted signs and sounds made to conform thereto, but rather that examination into the structure and usages of a language reveals possible classifications and the order of its development, and these reduced to systematic order furnish forth the grammar of that language.

Somewhat similarly we may regard the statement "that music makes the scales, and not scales the music," as true; and this being admitted, we have a general explanation of the uncertainties and changes that have characterized the minor scale. Music, like a living language, continues to grow, and laws sufficient at one stage become insufficient at a subsequent stage. Already we have considered the minor scale in three of its forms, known as diatonic, and we have remarked the defects in each. We have now to acquaint ourselves with the latest form it has assumed.

The difficulty all along has been with the upper tetrachord—Mi, Fa, Sol, La—which is not characteristically minor, and

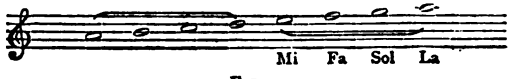


FIG. 1.

further offends in the absence of a leading note to La. Sol being raised a semitone, provided the required leading note, but increased the interval Fa—Sol♯ to three semitones, a second unfamiliar and difficult. By raising Fa a semitone, the ordinary major second of the diatonic scale was secured, but at the expense of making this tetrachord of the supposed minor scale absolutely identical with the upper tetrachord of the major scale The compromise of combining two different scales, one for ascending and one for descending, was adopted, but could not be considered final.

FIG. 2.

We retrace our steps to the point where the Sol♯ furnished the leading note to La, and instead of being scared by the second of three semitones, we accept it, familiarize ourselves with it, find it practicable, adopt it, and have a scale far superior to either of the others in beauty, character, and simplicity.

FIG. 3.

The truth of this will be felt on playing it over several times, and comparing its effect with that of the earlier scales.

It will be seen to consist of three tones, three semitones, and one augmented second (the one of three semitones). From this augmented second being other than the familiar diatonic seconds, and one which may be met with in what is called the chromatic scale (which see), the term chromatic minor scale has arisen. Nevertheless, some writers—as, for example, Mr. Currie ("Elements of Musical Analysis:" Laurie)—include this among the diatonic minor scales. He says in a foot-note, page 73, "Although the minor scale in this form of it exhibits an interval larger than a tone, it is still called diatonic."

From Fig. 3 we learn that the relative minor requires but one

accidental in addition to the signature of its major key, and that accidental has the effect of raising the seventh of the minor a semitone. Thus A minor is relative to C major. The signature of C major is open. A minor takes G♯ as an accidental. Other examples are here shown.

DOUBLE CHANT in D Minor. REV. J. LYON.

HANDEL'S "SOLOMON": No. 15, "Indulge thy Faith."

F♯ Minor.

Generally, then, the following rule holds good with regard to the chromatic minor scale. Any such scale being needed,—

1. Prefix the signature for the relative major (already learned to be a minor third above).
2. Write the scale of La to that signature.
3. Raise the seventh a semitone whenever it occurs.

Chromatic minor of the same base as the major. It is desirable to become familiar also with the differences existing between our minor and its major of the same base. A piece, say, in D major is required to be repeated in D minor. Of course we might alter the signature to one flat and play or sing as above; but if we can avoid altering the signature, so

much the better. Let us put a diagram of major and minor scales side by side, and learn from Fig. 4—

FIG. 4.

Major.		Minor.
Do		La
Si		Sol♯
La		Fa
Sol		Mi
Fa		Re
Mi		Do
Re		Si
Do		La

1. That they differ from each other but in two notes—the third and the sixth.

Note.—On account of this, some authors call these characteristic notes the modals of the scale.

2. That any major scale is at once made minor by bringing down its third and its sixth a semitone.

3. That any minor phrase or scale becomes major by raising its third and sixth a semitone.

An ordinary psalm tune will afford us the simplest illustrative example of these statements. Here is an old favourite called "Winchester New," a long measure tune in C major.

The above may be at once rendered minor by flattening the third and sixth of the tonic whenever they occur, thus :—

At (*a*) in the second phrase there is a modulation into the key of G, determined, as the student will remember from the explanations in earlier chapters of this Course, by the accidental F♯. Consequently, in rendering this portion minor, we have to regard G as the tonic, and flatten its third, B. Elsewhere in the piece the B is natural throughout. It will be noticed that though the second phrase closes so emphatically in G, the introduction of F♮ (the minor seventh of G) resolves the pieces back again into C, in which key it continues to the end.

In the following short example is illustrated the change of a minor phrase into a major:—

ROSSINI'S "MOSES IN EGYPT."

The Chromatic Intervals of the Scale.

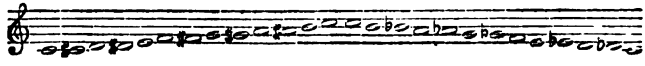
Let the student test this scale in the matter of its intervals, and he will find that there are four of these intervals not found in the diatonic scale. They are as follows :—

Fa to Sol♯ an augmented second of three semitones ;
Do to Sol♯ „ fifth of eight „ .

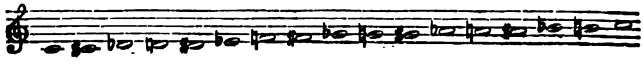
and the inversion of the augmented second, viz. :—

Sol to Fa a diminished seventh of nine semitones.

The word "chromatic" is derived from the Greek, and signifies coloured. It seems to have been applied to the scale rising and falling by semitones only, to signify a larger gradation in shades of tone. Here we have exhibited an octave of the chromatic scale ascending and descending, starting from C ; but a scale may start from any other pitch.



This example at once raises another question ; viz., why sharps should be used in ascending and flats in descending. In reply to this, we may state briefly (1) that though C♯, for instance, is interpreted on the key-board of a piano by the same key as D♭, yet C♯ is not of the same pitch in nature as D♭, and therefore some violence is done to music by that and similarly tempered instruments ; (2) that the sharpened notes are naturally and easily struck ascending, but with great difficulty descending, while the reverse holds good with regard to flattened notes. Hence this introduces a further refinement in the division of the intervals of the scale, shown in the following example,



which bears the name of the **Enharmonic Scale**, a word intended to signify higher musical quality. The interval from C♯ to D♭, for example, is called a **Diesis**, or enharmonic quartertone.

Long phrases in chromatic movement are not very common. The recitatives found in oratorios and some operas furnish frequent chromatic intervals in melody, while the following is an example of a chromatic sequence in harmony from the overture to Mendelssohn's "Athalie":—

Transposition.—Bearing in mind that a scale, air, or melody owes its character and effect, not to its pitch, but to the intervals existing between its sequence of notes, it follows that the pitch of any scale, air, or melody may be altered without altering its character and effect. For example, the major diatonic scale of C in no way differs from the major diatonic scale of E, except in the fact that the latter is throughout a major third higher in pitch than the former. What is more familiar than the fact of a tune being sung at almost any pitch? How often has a hymn tune been pitched too high or too low for convenient singing! Let the Old Hundredth be pitched as it may, we recognise the melody perfectly. Perhaps the student has seen our National Anthem written on different occasions in C, B ♭, or D.

When a piece is taken from one pitch and placed in another it is said to be transposed. And no musical exercise is so simple to a person well up in the key signatures as that of transposition. Let us take an illustration from a recent (August, 1880) Government Examination Paper. It was required to transpose the following into A (La) :—

Here we have a phrase in C. The notes are Do, Sol, Si♭, La, Si, Do, Re, Mi♭, Re, Do, Re, Sol, Do. We place the key signature of A (La) in our stave, and write Do, Sol, Si♭, etc., as follows:—

That the ♮ (natural) on G and C have precisely the same effect as the ♭ (flat) on B and E in the original need cause no surprise or be in the least difficult to understand by any careful student of this course of lessons.

Other Musical Signs and Terms. We may conclude this section of our studies by a few of the more ordinary signs and terms used in musical compositions.

Grace Notes are those notes introduced in a melody, and written in smaller character. They are directions for a little more elaboration in the performance, or what Rossini used to call embroidery. If they are left out, the piece is perfect in time and tune; but introduced, they add flourishes whose time of execution is deducted from that of the preceding or succeeding note. Advanced books deal with various ways of grouping grace notes, and use such terms as "appoggiatura," "accraccatura," and "grupetto." The only safe way of getting hold of the correct rendering of grace notes is to hear a first-rate performer execute them.

EXAMPLE, from Gluck's "Iphigenia in Tauris."

Besides grace notes, this example illustrates other signs.

The Turn ~ over the last two upper notes means that a somewhat similar flourish of three or four notes as that immediately preceding shall be performed before each note.

The Tie, or Slur, ⁀ ⁀ indicates that the notes which it groups together must be very smoothly rendered, or it may be that those notes go to one syllable. If this mark unites two notes of the same pitch, they are held on as one note, and the tie is properly so called.

Staccato, a dot over a note, as at B in the second bar, indicates that the note must be sharply struck, but not held on its whole time. Any number of notes in sequence or interrupted may be marked "staccato"; *f* = forte, or loud; *sf* = soave forte, or delicately loud; *p* = piano, or soft.

Other signs of intensity are *ff* = fortissimo, or very loud; *pp* = pianissimo, or very soft; < or *cres.* = crescendo, and means, get gradually louder; > or *dim.* = diminuendo, get gradually softer.

𝄐 over a note permits the prolongation of that note, and sometimes allows the introduction of a flourish.

The Repeat dots before or after a double bar, or both, direct the repetition of a passage ending or beginning there. *D.S.*, = dal segno, directs repetition from a sign, $, preceding it. *D.C.*, = da capo, directs repetition from the beginning.

The Trill, *tr.*, over a note has somewhat the same effect as the turn, only it confines the turn to two notes, the one written and the next below. These must alternate with great rapidity to produce the trill, or shake.

Of compositions, **the Ballad** originally meant a solemn song of praise, but now any popular song reciting some action or adventure. **The Recitative** is the reciting to musical tones without fixed time or measure of some action or passion. No predominant key is necessary, but the cadence, or closing part, must fall into a key related to the one in which the succeeding movement begins.

A Chorus is a piece sung by several voices in concert, and follows an air, song, or recitative.

A Glee, a song for several voices in parts.

A Duet, a piece for two performers.

A Trio, a piece for three performers.

A Quartett, a piece for four performers.

An Air, or **Aria,** the principal melody of a tune.

A Fugue, a chase or succession in the parts. The chief thought or sentiment in the piece is taken up alternately by the various parts.

A Canon is a perpetual fugue in which the different parts begin one after the other and repeat incessantly the same air.

An Opera is a dramatic composition set to music for performance on the stage, scenery and dresses being, of course, accessories. Properly, opera should have no speaking except to music, and should consist of songs, choruses, recitatives, etc.

An Oratorio is a musical composition on some Scripture subject generally, and consists of airs, recitatives, duets, trios, choruses, etc.

EXERCISES.

I.

1. Point out the differences between the Do and the La scales.
2. What definition can you give of a major as distinguished from a minor scale?
3. Point out the successive steps by which the minor scale assumed the form commonly called the diatonic minor.
4. What do you mean by the term relative, as applied to the major and minor scales?
5. Write the signatures for the minor keys of E, B♭, G, G♯, A, C.

II.

1. What do you mean by chromatic? and when are intervals

2. How does the chromatic minor differ from the diatonic minor?

3. How comes it that music scales and methods should be liable to alteration?

4. Make a list of all diatonic and chromatic intervals found in the chromatic minor scale.

5. Give a simple rule for at once reading off in the minor any major tune.

III.

1. What do you understand by enharmonic?

2. On what instrument can the enharmonic scale be illustrated? On what instrument can it not? Give your reasons for this as fully as you can.

3. Whereabouts in the enharmonic scale does the diesis occur?

4. If Do♯ is somewhat higher in pitch than Re♭, and so on with the rest, what will be the natural arrangement of the intervals to secure the continuous ascending and then descending enharmonic scale?

5. Why do you omit E♯ and F♭ in the above series? In what other part of the scale is there a similar omission?

IV.

1. Give the etymology of transposition, and show how the term applies to music.

2. What transposition is exceedingly common?

3. To what extent could the National Anthem be transposed? and why should it or any other tune be so treated?

4. Take a few bars in each of the different tune measures, and transpose them twice.

5. A tenor song in B♭ is required for a bass voice; point out the transposition necessary.

V.

1. Give examples of the use of the signs "staccato," "crescendo," "diminuendo," "fortissimo," "piano," "da capo," "dal segno," and supply the abbreviations.

2. Which of the above affect the intensity of the music? What do you mean by intensity? and how is the required intensity of a note secured?

3. What signs are used to affect the rate of movement, the rhythm, the repetition?

4. If you have access to any of the following, state (1) what they are, and (2) what variety of compositions they contain :—

Mendelssohn's "Athalie."
„ "Lauda Sion."
„ "Lobgesang."
Verdi's "Ballo in Maschera."
„ "Trovatore."
Flotow's "Stradella."
Meyerbeer's "Africaine."
Haydn's "Creation."
Handel's "Messiah."

5. Select convenient passages to transpose, and name intervals, chromatic and diatonic.

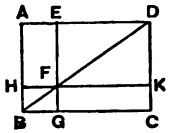
GEOMETRY.

EUCLID. BOOK II.

DEFINITIONS.

1. Every right-angled parallelogram is called a *rectangle*, and is said to be contained by any two of the straight lines which contain one of the right angles.

2. In every parallelogram, any one of the parallelograms about a diameter, together with the two complements, is called a *Gnomon*.



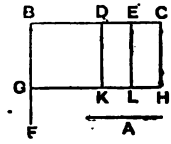
Thus the parallelogram H G, together with the complements A F, F C, is a gnomon, which is more briefly expressed by the letters A G K, or E H C, which are at the opposite angles of the parallelograms which make the gnomon.

Proposition I. Theorem.

If there be two straight lines, one of which is divided into any number of parts, the rectangle contained by the two straight lines is equal to the rectangles contained by the undivided line and the several parts of the divided line.

Let A and B C be two straight lines, and let B C be divided into any parts in the points D, E.

Then the rectangle contained by the straight lines A, B C shall be equal to the rectangle contained by A, B D, together with that contained by A, D E and that contained by A, E C.



From the point B draw B F at right angles to B C (I. 11).
Make B G equal to A (I. 3).
Through G draw G H parallel to B C (I. 31),
and through D, E, C draw D K, E L, C H parallel to B G.
Then the rectangle B H is equal to the rectangles B K, D L, E H.
But B H is contained by A, B C,
for it is contained by G B, B C ; and G B is equal to A :
B K is contained by A, B D,
for it is contained by G B, B D ; and G B is equal to A :
D L is contained by A, D E,
for it is contained by D K, D E ; and D K is equal to B G, or A :
and in like manner E H is contained by A, E C.
Therefore the rectangle contained by A, B C is equal to the rectangles contained by A, B D ; by A, D E ; and by A, E C.
Therefore, *if there be two straight lines*, etc.

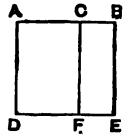
Q. E. D.

Proposition II. Theorem.

If a straight line be divided into any two parts, the rectangles contained by the whole and each of the parts are together equal to the square on the whole line.

Let the straight line A B be divided into any two parts in the point C.

Then the rectangle A B, B C* together with the rectangle A B, A C shall be equal to the square on A B.



Upon A B describe the square A D E B (I. 46),
through C draw C F parallel to A D or B E (I. 31).
Then A E is equal to the rectangles A F, C E.
But A E is the square on A B
and A F is the rectangle A B, A C,
for it is contained by D A, A C, and D A is equal to A B:
and C E is the rectangle A B, B C
for B E is equal to A B:
therefore the rectangle A B, B C together with the rectangle A B, A C
is equal to the square on A B.

Therefore, *if a straight line*, etc.

Q. E. D.

Proposition III. Theorem.

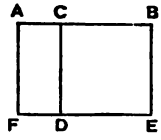
If a straight line be divided into any two parts, the rectangle contained by the whole and one of the parts is equal to the rectangle contained by the two parts, together with the square on the aforesaid part.

Let the straight line A B be divided into any two parts in the point C.

Then the rectangle A B, B C shall be equal to the rectangle A C, C B, together with the square on B C.

---

* This is the usual mode of indicating the rectangle *contained by* two straight lines, as A B and B C, and is employed by us in the present and following propositions for the sake of brevity. The square *on* a line, as A B, may also be called the square *of* the line.



Upon B C describe the square C D E B (I. 46),
produce E D to F.
Through A draw A F parallel to C D or B E (I. 31).
Then the rectangle A E is equal to the rectangles A D, C E.
But A E is the rectangle A B, B C
for it is contained by A B, B E, and B E is equal to B C.
Similarly, A D is the rectangle A C, C B
because C D is equal to C B.
And C E is the square on B C.
Therefore the rectangle A B, B C is equal to the rectangle A C, C B
together with the square on B C.
Therefore, *if a straight line*, etc.

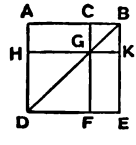
Q. E. D.

Proposition IV. Theorem.

If a straight line be divided into any two parts, the square on the whole line is equal to the squares on the two parts, together with twice the rectangle contained by the parts.

Let the straight line A B be divided into any two parts in C.

Then the square on A B shall be equal to the squares on A C, C B, together with twice the rectangle A C, C B.



Upon A B describe the square A D E B (I. 46). Join B D.

Through C draw C G F parallel to A D or B E.
Then, because C F is parallel to A D and B D falls upon them,
therefore the angle C G B is equal to the angle A D B (I. 29).
But the angle A D B is equal to the angle A B D (I. 5).
because A D is equal to A B, being two sides of a square,
therefore the angle C G B is equal to the angle C B G,
and the side C G is equal to the side C B (I. 6).
But C G is equal to B K, and C B to G K (I. 34)
therefore the figure C G K B is equilateral.
It is also rectangular.
For, because C G is parallel to B K, and C B falls upon them,
therefore the angles K B C, G C B are equal to two right angles (I. 29).
But the angle K B C is a right angle (*constr.*),
therefore G C B is a right angle,
and therefore also the angles C G K, G K B, opposite to these, are right angles,
and C G K B is rectangular.
It has also been shown to be equilateral,
therefore it is a square, and it is upon the side C B.
For the like reason H F is a square,
and it is upon the side H G, which is equal to A C.
Therefore H F, C K are the squares of A C, C B.
And because the complement A G is equal to the complement G E (I. 43)
and that A G is the rectangle A C, C B,
for C G is equal to C B,
therefore also G E is equal to the rectangle A C, C B,
and A G, G E are together equal to twice the rectangle A C, C B.
Also H F, C K are the squares on A C, C B.
Therefore the four figures H F, C K, A G, G E are together equal to the squares on A C, C B and twice the rectangle A C, C B.
But H F, C K, A G, G E make up the whole figure A D E B, which is the square on A B.
Therefore the square on A B is equal to the squares

on A C, C B and twice the rectangle A C, C B.

Therefore, *if a straight line*, etc.

Q. E. D.

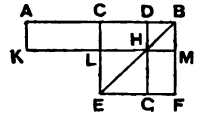
COR. From the demonstration it is manifest that the parallelograms about the diameter of a square are likewise squares.

Proposition V. Theorem.

If a straight line be divided into two equal parts and also into two unequal parts; the rectangle contained by the unequal parts, together with the square on the line between the points of section, is equal to the square on half the line.

Let the straight line A B be divided into two equal parts in the point C, and into two unequal parts in the point D.

Then the rectangle A D, D B together with the square on C D shall be equal to the square on C B.



Upon C B describe the square C E F B (I. 46).

Join B E;

through D draw D H G parallel to C E or B F (I. 31);

through H draw K L M parallel to C B or E F;

and through A draw A K parallel to C L or B M.

Then, because the complement C H is equal to the complement H F (I. 43),

to each of these equals add D M;

therefore the whole C M is equal to the whole D F.

But C M is equal to A L,

because A C is equal to C B (I. 36),

therefore also A L is equal to D F.

To each of these equals add C H,

therefore the whole A H is equal to D F and C H.

But A H is the rectangle contained by A D, D B,
for D H is equal to D B,
and D F together with C H is the gnomon C M G,
therefore the rectangle A D, D B is equal to the gnomon C M G.
To each of these add L G, which is equal to the square on C D
(II. 4 Cor.),
therefore the rectangle A D, D B, together with the square of C D,
is equal to the gnomon C M G, together with L G.
But the gnomon C M G and L G make up the whole figure
C E F B,
which is the square on C B;
therefore the rectangle A D, D B together with the square on C D,
is equal to the square on C B.

Therefore, *if a straight line*, etc.

Q. E. D.

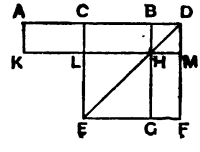
COR. From this proposition it is manifest that the difference of the squares on two unequal lines A C, C D is equal to the rectangle contained by their sum and difference.

Proposition VI. Theorem.

If a straight line be bisected and produced to any point, the rectangle contained by the whole line thus produced and the part of it produced, together with the square on half the line bisected, is equal to the square on the straight line which is made up of the half and the part produced.

Let the straight line A B be bisected in C and produced to the point D.

Then the rectangle A D, D B, together with the square on C B, shall be equal to the square on C D.



Upon C D describe the square C E F D (I. 46).
Join D E;
through B draw B H G parallel to C E or D F (I. 31);
through H draw K L M parallel to A D or E F,
and through A draw A K parallel to C L or D M.
Then, because A C is equal to C B,
therefore the rectangle A L is equal to the rectangle C H (I. 36).
But C H is equal to H F (I. 43),
therefore A L is equal to H F;
to each of these equals add C M,
therefore the whole A M is equal to the gnonom C M G.
But A M is the rectangle A D, D B.
for D M is equal to D B (II. 4. Cor.),
therefore the rectangle A D, D B is equal to the gnomon C M G.
To each of these add L G,
which is equal to the square on C B;
therefore the rectangle A D, D B, together with the square on C B,
is equal to the gnomon C M G and the figure L G.
But the gnomon C M G and L G make up the whole figure C E F D,
which is the square on C D;
therefore the rectangle A D, D B, together with the square on C B,
is equal to the square on C D.
Therefore, *if a straight line*, etc.

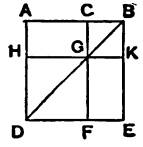
Q. E. D.

Proposition VII. Theorem.

If a straight line be divided into any two parts, the squares on the whole line and on one of the parts are equal to twice the rectangle contained by the whole and that part, together with the square on the other part.

Let the straight line A B be divided into any two parts in the point C.

Then the squares on A B, B C shall be equal to twice the rectangle A B, B C, together with the square on A C.



Upon A B describe the square A D E B (I. 46).
Join B D;
through C draw C F parallel to A D or B E, cutting B D in G (I. 31),
and through G draw H G K parallel to A B or D E.
Then, because A G is equal to G E (I. 43),
to each of these equals add C K;
therefore the whole A K is equal to the whole C E,
and therefore A K, C E are double of A K.
But A K, C E are the gnomon A K F and the square C K;
therefore the gnomon A K F and the square C K are double of A K.
But twice the rectangle A B, B C is double of A K,
since B K is equal to B C (II. 4 Cor.),
therefore the gnomon A K F and the square C K
are equal to twice the rectangle A B, B C.
To each of these equals add H F,
which is equal to the square on A C;
therefore the gnomon A K F, and the squares C K, H F are equal to twice the rectangle A B, B C and the square on A C.
But the gnomon A K F, together with the squares C K, H F make up the whole figure A D E B and C K,
which are the squares on A B and B C;
therefore the squares on A B, B C are equal to twice the rectangle A B, B C, together with the square on A C.
Therefore, *if a straight line*, etc.

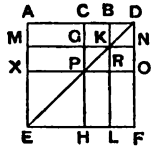
Q. E. D.

Proposition VIII. Theorem.

If a straight line be divided into any two parts, four times the rectangle contained by the whole line and one of the parts, together with the square on the other part, is equal to the square on the straight line which is made up of the whole and that part.

Let the straight line A B be divided into any two parts in the point C.

Then four times the rectangle A B, B C, together with the square on A C, shall be equal to the square on the straight line made up of A B and B C together.



Produce A B to D, making B D equal to C B (I. 3).

Upon A D describe the square A E F D (I. 46); join D E.

Through B, C, draw B L, C H parallel to A E or D F (I. 31), cutting D E in K and P;

and through K, P, draw M G K N, X P R O, parallel to A D or E F.

Then, because C B is equal to B D, C B to G K, and B D to K N therefore G K is equal to K N;

for the same reason P R is equal to R O.

And, because C B is equal to B D, and G K to K N, therefore the rectangle C K is equal to B N,

and G R to R N (I. 36);

but C K is equal to R N (I. 43),

because they are complements of the parallelogram C O; therefore also B N is equal to G R;

and therefore the four rectangles B N, C K, G R, R N are equal to one another, and are together quadruple of one of them, C K.

Again, because C B is equal to B D, and B D to B K, that is, to C G;

and C B is equal to G K, that is, to G P;
therefore C G is equal to G P.
And because C G is equal to G P, and PR to R O,
therefore the rectangle A G is equal to M P, and P L to R F.
But the rectangle M P is equal to P L (I. 43),
because they are the complements of the parallelogram M L,
therefore also A G is equal to R F,
therefore the four rectangles A G, M P, P L, R F are equal to one another, and are together quadruple of one of them, A G.
And it was demonstrated that the four, C K, B N, G R, and R N, are quadruple of C K;
therefore the eight rectangles which form the gnomon A O H are quadruple of A K.
And because A K is the rectangle A B, B C,
for B K is equal to B C;
therefore four times the rectangle A B, B C is quadruple of A K.
But the gnomon A O H was shown to be quadruple of A K,
therefore four times the rectangle A B, B C is equal to the gnomon A O H;
to each of these equals add X H, which is equal to the square on A C;
therefore four times the rectangle A B, B C, together with the square on A C, is equal to the gnomon A O H and the square X H.
But the gnomon A O H and X H make up the figure A E F D, which is the square on A D;
therefore four times the rectangle A B, B C, together with the square on A C, is equal to the square on A D,
that is, of A B and B C added together in one straight line.
Therefore, *if a straight line*, etc.

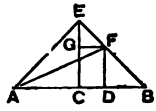
Q. E. D.

Proposition IX. Theorem.

If a straight line be divided into two equal and also into two unequal parts, the squares on the two unequal parts are together double of the square on half the line and of the square on the line between the points of section.

Let the straight line A B be divided into two equal parts in the point C, and into two unequal parts in the point D.

Then the squares on A D, D B shall be together double of the squares on A C, C D.



From the point C draw C E at right angles to A B (I. 11);
make C E equal to A C or C B (I. 3);
join E A, E B.
Through D draw D F parallel to C E, meeting E B in F (I. 31);
and through F draw F G parallel to B A.
Join A F.
Then, because A C is equal to C E,
therefore the angle E A C is equal to the angle A E C (I. 5);
and because A C E is a right angle,
therefore the two other angles A E C, E A C of the triangle C A E
are equal to a right angle (I. 32);
but they are equal to each other,
therefore each of them is half a right angle.
For the like reason, each of the angles C B E, C E B is half a right angle.
Therefore the whole angle A E B is a right angle.
And because the angle G E F is half a right angle,
and E G F is a right angle,
for it is equal to the interior and opposite angle, E C B (I. 29),
therefore the remaining angle, G F E, is half a right angle.
Therefore the angle G E F is equal to the angle G F E,
and the side G E is equal to the side G F (I. 6).
Again, because the angle at B is half a right angle,
and F D B is a right angle,
for it is equal to the interior and opposite angle E C B,
therefore the remaining angle, D F B, is half a right angle;
therefore the angle D B F is equal to the angle D F B,

and the side D B is equal to the side D F (I. 6).

Then, because A C is equal to C E,

therefore the square on A C is equal to the square on C E,

and therefore the squares on A C, C E are double of the square on A C.

But the square on A E is equal to the squares on A C, C E (I. 47), because A C E is a right angle;

therefore the square on A E is double of the square on A C.

Again, because E G is equal to G F,

therefore the square on E G is equal to the square on G F,

and therefore the squares on E G, G F are double of the square on G F.

But the square on E F is equal to the squares on E G, G F (I 47).

therefore the square on E F is double of the square on G F, that is, of the square on C D (I. 34).

And the square on A E is double of the square on A C,

therefore the squares on A E, E F are double of the squares on A C, C D.

And the square on A F is equal to the squares on A E, E F (I. 47), because A E F is a right angle;

therefore the square on A F is double of the squares on A C, C D.

And the square on A F is equal to the squares on A D, D F (I. 47) because A D F is a right angle;

therefore the squares on A D, D F are double of the squares on A C, C D.

And D F is equal to D B,

therefore the squares on A D, D B are double of the squares on A C, C D.

Therefore, *if a straight line*, etc.

Q. E. D.

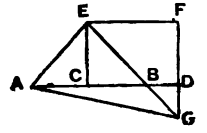
Proposition X. Theorem.

If a straight line be bisected and produced to any point, the squares on the whole line thus produced and on the part of it produced are together double of the square on half the line bi-

sected, and of the square on the line made up of the half and the part produced.

Let the straight line A B be bisected in C and produced to D.

Then the squares on A D, D B shall be double of the squares on A C, C D.



From the point C draw C E at right angles to A B (I. 11);
make C E equal to A C or C B (I. 3);
join A E, A B.
Through E draw E F parallel to A B (I. 31)
and through D draw D F parallel to C E.

Then, because E C is parallel to F D and E F falls upon them, therefore the angles C E F, E F D are equal to two right angles, and therefore the angles B E F, E F D are less than two right angles.

But if a straight line meets two straight lines so as to make the two interior angles on the same side together less than two right angles, these straight lines, being continually produced, shall at length meet upon that side on which are the angles which are less than two right angles (*Ax.* 12);
therefore E B, F D will meet if produced towards B, D.
Let these be produced and meet in G; join A G.
Then, because C A is equal to C E,
therefore the angle C A E is equal to the angle C E A (I. 5).
But the angle A C E is a right angle,
therefore each of the angles C A E, C E A is half a right angle.
For the like reason each of the angles C B E, C E B is half a right angle;
therefore A E B is a right angle.
And because the angle D B G is half a right angle,

for it is equal to the angle E B C (I. 15),
and that B D G is a right angle,
for it is equal to the alternate angle D C E (I. 29),
therefore the remaining angle D G B is half a right angle;
therefore the angle D G B is equal to the angle D B G,
and therefore the side D G is equal to the side B D (I. 6).
Again, because F G E is half a right angle,
and E F G is a right angle,
for it is equal to the opposite angle E C D (I. 34),
therefore the remaining angle F E G is half a right angle;
therefore the angle F E G is equal to the angle F G E,
and therefore the side F E is equal to the side F G (I. 6).
And because A C is equal to C E,
therefore the square on A C is equal to the square on C E,
and therefore the squares on A C, C E are double of the square on A C.
But the square on A E is equal to the squares on A C, C E,
therefore the square on A E is double of the square on A C.
Again, because E F is equal to F G,
therefore the square on E F is equal to the square on F G,
and therefore the squares on E F, F G are double of the square on E F.
But the square on E G is equal to the squares on EF, F G;
therefore the square on E G is double of the square on E F;
and E F is equal to C D (I. 34)
therefore the square on E G is double of the square on C D.
And it has been demonstrated
that the square on A E is double of the square on A C,
therefore the squares on A E, E G are double of the squares on A C, C D.
But the square on A G is equal to the squares on A E, E G (I. 47),
therefore the square on A G is double of the squares on A C, C D.
And the square on A G is equal to the squares on A D, D G,
therefore the squares on A D, D G are double of the squares on A C, C D.

And D G is equal to D B,
therefore the squares on A D, D B are double of the squares on A C, C D.

Therefore, *if a straight line*, etc.

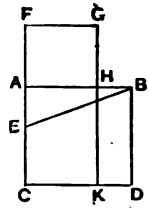
Q. E. D.

Proposition XI. Problem.

To divide a straight line into two parts, so that the rectangle contained by the whole and one of the parts shall be equal to the square on the other part.

Let A B be the given straight line.

It is required to divide it into two parts, so that the rectangle contained by the whole and one of the parts shall be equal to the square on the other part.



Upon A B describe the square A C D B (I. 46)
bisect A C in E (I. 10); join B E.
Produce C A to F, making E F equal to E B (I. 3).
Upon A F describe the square A F G H (I. 46).
Then A B shall be divided in H so that the rectangle A B, B H is equal to the square on A H.
Produce G H to meet C D in K.
Then, because A C is bisected in E and produced to F, therefore the rectangle C F, F A, together with the square on A E,
is equal to the square on E F (II. 6).
But E F is equal to E B;

therefore the rectangle C F, F A, together with the square on A E,
is equal to the square on E B.
And the square on E B is equal to the squares on A E, A B (I. 47),
because E A B is a right angle;
therefore the rectangle C F, F A, together with the square on A E,
is equal to the squares on A E, A B.
Take away the common square on A E;
therefore the remainder, the rectangle C F, F A,
is equal to the square on A B.
But the figure F K is the rectangle C F, F A,
for F G is equal to F A;
and A D is the square on A B;
therefore F K is equal to A D.
Take away the common part A K,
therefore the remainder F H is equal to the remainder H D.
But H D is the rectangle A B, B H,
for A B is equal to B D;
and F H is the square on A H;
therefore the rectangle A B, B H is equal to the square on A H.

Therefore the given straight line A B is divided in H so that the rectangle A B, B H is equal to the square on A H.

Q. E. F.

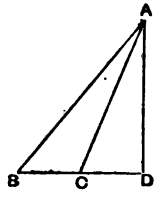
Proposition XII. Theorem.

In obtuse-angled triangles, if a perpendicular be drawn from either of the acute angles to the opposite side produced, the square on the side subtending the obtuse angle is greater than the squares on the sides containing the obtuse angle by twice the rectangle contained by the side upon which, when produced, the perpendicular falls, and the straight line intercepted without the triangle between the perpendicular and the obtuse angle.

Let A B C be an obtuse-angled triangle, having the obtuse

angle A C B, and from the point A let A D be drawn perpendicular to B C produced.

Then the square on A B shall be greater than the squares on A C, C B by twice the rectangle B C, C D.



Because the straight line B D is divided into two parts in C,
therefore the square on B D is equal to the squares on B C, C D
and twice the rectangle B C, C D (II. 4).
To each of these equals add the square on D A,
therefore the squares on B D, D A are equal to the squares on
B C, C D, D A,
and twice the rectangle B C, C D.
But the square on B A is equal to the squares on B D, D A (I. 47),
because the angle at D is a right angle ;
and the square on C A is equal to the squares on C D, D A.
Therefore the square on B A is equal to the squares on B C, C A,
and twice the rectangle B C, C D ;
that is, the square on B A is greater than the squares on B C, C A,
by twice the rectangle B C, C D.

Therefore, *in obtuse-angled triangles*, etc.

Q. E. D.

Proposition XIII. Theorem.

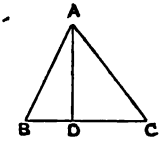
In every triangle, the square on the side subtending either of the acute angles is less than the squares on the sides containing that angle by twice the rectangle contained by either of these sides, and the straight line intercepted between the acute angle and the perpendicular let fall upon it from the opposite angle.

Let A B C be any triangle, and the angle at B one of its

acute angles ; and upon B C, one of the sides containing it, let fall the perpendicular A D from the opposite angle.

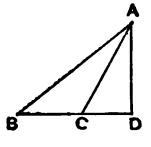
Then the square on A C, opposite to the angle B, shall be less than the squares on C B, B A, by twice the rectangle C B, D B.

First, let A D fall within the triangle A B C.



Then, because C B is divided into two parts in the point D,
therefore the squares on C B, B D are equal to twice the rectangle C B, B D and the square on C D (II. 7) ;
to each of these equals add the square on D A ;
therefore the squares on C B, B D, D A are equal to twice the rectangle C B, B D and the squares on C D, D A.
But the square on B A is equal to the squares on B D, D A (I. 47), because B D A is a right angle ;
and the square on A C is equal to the squares on C D, D A ;
therefore the squares on C B, B A are equal to the square on A C, and twice the rectangle C B, B D ;
that is, the square on A C alone is less than the squares on C B, B A by twice the rectangle C B, B D.

Secondly, let A D fall without the triangle A B C.



Then, because the angle at D is a right angle,
therefore the angle A C B is greater than a right angle (I. 16),
therefore the square on A B is equal to the squares on A C, C B, and twice the rectangle B C, C D (II. 12).

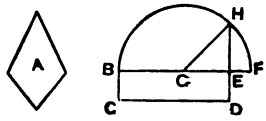
To each of these equals add the square on B C;
therefore the squares on A B, B C are equal to the square on A C, twice the rectangle B C, C D and twice the square on B C.
But, because B D is divided into two parts in C,
therefore the rectangle D B, B C is equal to the rectangle B C, C D, and the square on B C (II. 3);
and the doubles of equals are equal,
therefore twice the rectangle D B, B C is equal to twice the rectangle B C, C D, and twice the square on B C;
therefore the squares on A B, B C are equal to the square on A C, and twice the rectangle D B, B C;
that is, the square on A C alone is less than the squares on A B, B C
by twice the rectangle D B, B C.
Lastly, let the side A C be perpendicular to B C.

Then B C is the straight line between the perpendicular and the acute angle at B;
and it is manifest that the squares on A B, B C are equal to the square on A C and twice the square on B C (I. 47).
Therefore, *in any triangle*, etc. Q. E. D.

Proposition XIV. Problem.

To describe a square that shall be equal to a given rectilineal figure.

Let A be the given rectilineal figure.
It is required to describe a square that shall be equal to A.



Describe the rectangular parallelogram B C D E
equal to the rectilineal figure A (I. 45).
Then, if the sides of it, B E, E D, are equal to one another,
then it is a square, and what was required is now done.
But if the sides B E, E D, are not equal,
produce one of them B E to F, making E F equal to E D (I. 3);
bisect B F in G (I. 10).
From the centre G, at the distance G B or G F, describe the
semicircle B H F;
produce D E to meet the circumference in H.
Then the square described on H E shall be equal to
the given rectilineal figure A.
Join G H.
Because B F is divided into two equal parts in G,
and into two unequal parts in E;
therefore the rectangle B E, E F, together with the square on E G,
is equal to the square on G F (II. 5).
But G F is equal to G H,
because G is the centre of the semicircle B H F;
therefore the rectangle B E, E F, together with the square on E G,
is equal to the square on G H.
But the square on G H is equal to the squares on H E, E G (I. 47),
therefore the rectangle B E, E F, together with the square on E G,
is equal to the squares on H E, E G.
Take away the common square on E G;
therefore the rectangle B E, E F is equal to the square on H E.
But the rectangle B E, E F is the parallelogram B D,
because E F is equal to E D;
therefore B D is equal to the square on H E.
But B D is equal to the rectilineal figure A (*constr.*),
therefore the square on E H is equal to the rectilineal figure A.

Therefore a square has been made equal to the given rectilineal figure A, namely, the square described on E H.

Q. E. F.

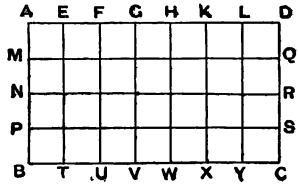
NOTES TO EUCLID—BOOK II.

It will be useful here to explain the connection between Geometry and Algebra. The former relates to *magnitude*, the latter to *number*. Lines and areas cannot properly be represented by numbers; hence an algebraical cannot absolutely be substituted for a geometrical proof of any theory, but we can in many cases find an algebraical process and result representing the corresponding geometrical process and result.

We cannot represent a line itself by means of a *number*, but if we take a certain unit of length, we can speak of the line as containing so many of those units of length. Thus, if the unit be an inch, a line may be spoken of as containing 3, 4, 5, or any number of inches.

A rectangle may also be denoted by a number.

Let A B C D be a rectangle. Suppose the line A B to contain 4 linear units and the line B C to contain 7 linear units.



Through the points of division, marking the number of units in A B and D C, draw M Q, N R, P S, parallel to A D or B C, and E T, F U, G V, H W, K X, L Y, parallel to A B or D C.

The rectangle A B C D is now divided into a number of squares, exactly equal to each other; and each of them is the square described on a line containing one linear unit.

Now, taking one of these squares as the *unit of area*, we find that the rectangle contains 7×4 of these units. For there are 4 rows of squares, and each row contains 7 squares. Therefore the rectangle may be denoted by 7×4, or 28.

In other words, the rectangle may be denoted by the *product* of the two numbers denoting the length and breadth of the rectangle.

Hence, generally, if one side of the rectangle contain p units of length and the other side contain q units of length, then the rectangle contains $p \times q$ or pq superficial units, or units of area. Or—

$$\text{Area rectangle} = p \times q = pq.$$

If the two sides of the rectangle be equal, then the figure is a square, and $p = q$.

$$\therefore \text{Area} = p \times q = p \times p = p^2.$$

In the following notes it will be seen that each of the first ten theorems of the Second Book of Euclid may be shown to agree with a corresponding algebraical expression.

Prop. I. Let the line B C contain a linear units and the line A contain b linear units.

Also let the parts B D, D E, E C contain m, n, p units respectively.

$$\text{Then } a = m + n + p$$
$$\text{Multiply each side by } b$$
$$\therefore ab = bm + bn + bp,$$

which is the algebraical result corresponding with the geometrical theorem contained in this proposition.

Prop. II. This is only a particular case of Proposition I., obtained by taking A equal to B C (in Prop. I.) and dividing B C into two parts only.

Let A C contain a linear units and C B contain b linear units.

Then A B contains $a + b$ linear units;

$$(a + b)\,a + (a + b)\,b = (a + b)\,(a + b)$$
$$= (a + b)^2,$$

which is the corresponding result in Algebra.

Or thus (as in the First Proposition) :—

Let A B contain a linear units, and A C, C B contain m and n linear units respectively.

Then $m + n = a$

Multiply each side by a,

$\therefore am + an = a^2$,

which is the corresponding result in Algebra.

Prop. III. This proposition is also a particular case of Proposition I., obtained by dividing B C into two parts, and taking A equal to one of the parts.

Let A C contain a linear units and C B contain b linear units.

Then A B contains $a + b$ linear units.

$(a + b)\, b = ab + b^2$,

which is the corresponding result in Algebra.

Or thus (as in the First Proposition) :—

Let A B contain a linear units and B C, A C contain m and n linear units respectively.

Then $a = n + m$.

Multiply each side by m,

$\therefore ma = mn + m^2$.

Prop. IV. If A C be equal to C B, then the rectangle A C, C B is equal to the square on A C or C B ; therefore the square on the whole line is equal to four times the square on half the line.

Let A C contain a linear units, and C B b linear units.

Then A B contains $a + b$ linear units.

$(a + b)^2 = a^2 + b^2 + 2ab$,

which is the corresponding result in Algebra.

Prop. V. Let B C or A C contain a linear units.

Then A B contains $2a$ linear units.

Let C D contain c linear units.

Then A D contains $a + c$ linear units, and D B contains $a - c$ linear units.

Then $(a + c)(a - c) = a^2 - c^2$.

Add c^2 to each side,

$\therefore (a + c)(a - c) + c^2 = a^2$,

which is the corresponding result in Algebra.

Prop. VI.

Let B C or A C contain a linear units.
Then A B contains $2a$ linear units.
Let B D contain b linear units.
Then A D contains $2a + b$ linear units,
And C D contains $a + b$ linear units.

$$a^2 + 2ab + b^2 = (a + b)^2$$
$$\therefore (2a + b)\, b + a^2 = (a + b)^2,$$

which is the corresponding result in Algebra.

Prop. VII.

Let A B contain a linear units.
Also let A C, B C contain m, n linear units respectively.

$$\text{Then } a = m + n$$
$$\therefore a^2 = m^2 + 2mn + n^2$$
$$\therefore a^2 + n^2 = m^2 + 2mn + 2n^2$$
$$= m^2 + 2(m + n)\, n$$
$$= 2an + m^2,$$

which is the corresponding result in Algebra.

Or thus :—

Let A B contain a linear units,
And B C contain b linear units.
Then A C contains $a - b$ linear units.

$$a^2 - 2ab + b^2 = (a - b)^2$$
$$\therefore a^2 + b^2 = 2ab + (a - b)^2,$$

which is the corresponding result in Algebra.

Prop. VIII.

Let A B contain a linear units.
Also let A C, C B contain m, n linear units respectively.

$$\text{Then } m = a - n$$
$$\therefore 4an + m^2 = 4an + (a - n)^2$$
$$= 4an + a^2 - 2an + n^2$$
$$= a^2 + 2an + n^2$$
$$= (a + n)^2,$$

which is the corresponding result in Algebra.

Prop. IX.

Let A C or C B contain a linear units,
and C D contain b linear units.
Then A B contains $2a$ linear units.
Also A D contains $a+b$ linear units, and D B contains $a-b$ linear units.

$$(a+b)^2+(a-b)^2 = a^2+2ab+b^2+a^2-2ab+b^2$$
$$= a^2+b^2+a^2+b^2$$
$$= 2a^2+2b^2,$$

which is the corresponding result in Algebra.

Prop. X.

This proposition may be proved thus:—
Let the straight line A B be bisected in C and produced to D.
Produce D A to E, making A E equal to B D.
Then, since E D is divided into two equal parts in C,
and into two unequal parts in A,
therefore the squares on A D, A E are double of the squares on A C, C D (II. 9).
But A E is equal to D B,
therefore the squares on A D, D B are double of the squares on A C, C D. Q. E. D.

Let A C or C B contain a linear units.
Let B D contain b linear units.
Then A B contains $2a$ linear units, A D contains $2a+b$ linear units, and C D contains $a+b$ linear units.

$$(2a+b)^2+b^2 = 4a^2+4ab+b^2+b^2$$
$$= 2a^2+2a^2+4ab+2b^2$$
$$= 2a^2+2(a^2+2ab+b^2)$$
$$= 2a^2+2(a+b)^2,$$

which is the corresponding result in Algebra.

Prop. XI.

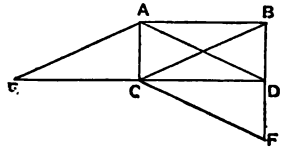
The lines E B, C D, F C, G K, are divided in a similar manner to A B.

GEOMETRICAL EXERCISES

TO EUCLID I. AND II.

Note.—Exercises marked thus * are selected from Government Examination Papers for Third and Fourth Years and for Queen's Scholarships.

* (1) Show that the area of a triangle formed by the diagonals of an oblong and a line equal to twice the length of either of its sides is equal to the area of the oblong.



Let A C D B be the oblong, whose diagonals are A D, B C.

(*a*) Produce D C to E, making E C equal to D C. Join A E.

Then in the triangles A C D, B C D, because A C, C D are equal to B D, D C each to each, and the angle A C D is equal to the angle B D C, therefore the base A D is equal to the base B C (I. 4); that is, the diagonals are equal to each other.

Again, because in the triangles A E C, A D C; E C, C A are equal to D C, C A, each to each, and the angle A C E is equal to the angle A C D, therefore the base A E is equal to the base A D (I. 4); that is, A E is equal to either of the diagonals; and the triangle A E C is equal to the triangle A D C. Therefore the whole triangle A E D is double of the triangle A D C.

But the oblong A C D B is also double of the triangle A D C (I. 34), therefore the whole triangle A E D is equal to the oblong A C D B; and the triangle A E D is formed by the straight lines A D, A E, and E D, that is by the two diagonals and a line equal to twice the length of one of the sides C D.

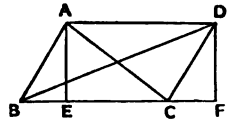
(*b*) Produce B D to F, making D F equal B D. Join C F. In the same way it may be proved that the triangle B C F is

formed by the diagonals and a line equal to twice the length of the other side, B D, and that it is equal to the oblong A C D B.

* (2) Draw a figure showing that two triangles may have two sides and one angle equal in each, and yet may not be equal.

* (3) The squares of the diagonals of a parallelogram are together equal to the squares of the four sides.

Let A B C D be a parallelogram having the diagonals A C, B D.



From A and D draw A E, D F, perpendicular to B C or B C produced (I. 12).

Then in the triangles A B E, D C F, since the angles A B E, A E B and the side A B are equal to the angles D C F, D F C and the side D C, each to each; therefore B E is equal C F (I. 26).

Now the square on B D is equal to the squares on B C and C D, together with twice the rectangle B C, C F (II. 12).

And the square on A C, together with twice the rectangle B E, B C, is equal to the squares on A B and B C (II. 13).

Adding these equals we have; the squares on B D and A C, together with twice the rectangle B E, B C, are equal to the squares on B C, C D, A B, B C, together with twice the rectangle B C, C F.

But twice the rectangle B E, B C is equal to twice the rectangle B C, C F, since B E is equal to C F.

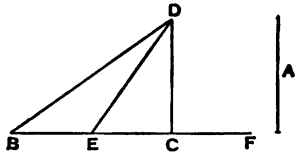
Therefore the remainder, the squares on B D and A C, is equal to the remainder, the squares on B C, C D, A B, B C; that is, to the squares on B C, C D, A B, A D. Q. E. D.

* (4) From Euc. II. 2 deduce that the square on a straight line is equal to four times the square on half the line.

* (5) How could you describe a rectangle equal to a given

square and having one of its sides equal to a given straight line?

Let A be a side of the given square, and B C the given straight line.



From C draw C D at right angles to B C (I. 11) make C D equal to A (I. 3). Join B D.

At the point D make the angle B D E equal to D B E. Then B E is equal to E D. Produce B C to F, making E F equal to E B or D E (I. 3). Then the rectangle contained by B C, C F shall be the rectangle required.

For the square on D E is equal to the squares on E C, C D (I. 47).

Therefore the square on E F is equal to the squares on E C, C D.

But the square on E F is equal to the square on E C, together with the rectangle contained by B C, C F (II. 5).

Therefore the squares on E C, C D are equal to the square on E C, together with the rectangle contained by B C, C F. Take away the common square of E C, and the square of C D is equal to the rectangle B C, C F. But the square on C D is equal to the given square on A. Therefore rectangle B C, C F is the rectangle required.

* (6) The difference between the squares on any two straight lines is equal to the rectangle contained by the sum and difference of those lines. Prove it.

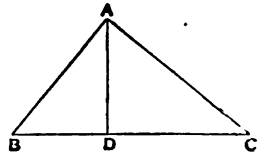
Note.—This is the corollary to Euc. II. 5, and corresponds with the algebraical formula $a^2 - b^2 = (a+b)(a-b)$.

* (7) If a straight line be divided into two parts so that the rectangle contained by the whole and the first part is equal to

the square of the second part, then must the squares on the whole line and on the first part be equal to three times the square on the second part.

* (8) If the square on the perpendicular from the vertex of a triangle to the base is equal to the rectangle contained by the segments of the base, the vertical angle is a right angle.

Let A B C be a triangle, and let A D be the perpendicular from the vertex A to the base B C. Let the square on A D be equal to the rectangle B D, D C. Then B A C shall be a right angle.



The square on B C is equal to the squares on B D, D C, together with twice the rectangle B D, D C (II. 4).

But the square on A D is equal to the rectangle B D, D C; therefore the square on B C is equal to the squares on B D, D C together with twice the square on A D.

Also the square on A B is equal to the squares on B D, A D (I. 47); and the square on A C is equal to the squares on A D, D C (I. 47); therefore also the squares on A B, A C are together equal to the squares on B D, D C, together with twice the square on A D:

Therefore the square on B C is equal to the squares on A B, A C; therefore the vertical angle B A C is a right angle (I. 48).

Q. E. D.

* (9) The parallelograms about the diagonal of a square are also squares.

* (10) Euc. I. 2. If you are able, prove this proposition by joining the *point* to the extremity of the given line which is *the farther removed from it*, instead of the nearer one, as in Euclid.

* (11) If two right-angled isosceles triangles have their bases equal, they will be equal in all respects.

* (12) If a quadrilateral is bisected by each of its two diagonals, it is a parallelogram.

* (13) Show that if two lines bisect the opposite sides of a trapezium, they also bisect each other.

* (14) A B C is a triangle right-angled at A, and the angle B is double of the angle C. Show that the side C B is double of the side A B.

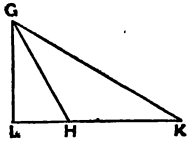
* (15) Two equal perpendiculars, P A, Q B, are drawn to the line A B from points, P, Q, on opposite sides of A B; A B is bisected in O. Show that P O Q is a straight line.

Let the pupil draw the figure, and first prove by Euc. I. 4, that the angle P O A is equal to the angle Q O B.

Then, since P O A, P O B are equal to two right angles (I. 13), and P O A is equal to Q O B, therefore P O B and Q O B are equal to two right angles, and therefore P O, Q O are in the same straight line.

* (16) In an isosceles obtuse-angled triangle, the square on the side subtending the obtuse angle is equal to twice the rectangle contained by either side and the straight line made up of that side and the straight line intercepted without the triangle between the perpendicular and the obtuse angle.

Let G H K be an isosceles triangle, having G H equal to H K, and let G H K be an obtuse angle. Let G L be the perpendicular on K H produced. Then, it is required to prove that the square on G K is equal to twice the rectangle K H, K L.



Since G H K is an obtuse angle, therefore the square on G K is equal to the squares on G H, H K, together with twice the rectangle K H, H L. But G H is equal to H K, therefore the squares on GH, H K are equal to twice the square on H K;

therefore the square on G K is equal to twice the square on H K, together with twice the rectangle K H, H L.

But the rectangle K H, K L is equal to the square on H K, together with the rectangle K H, H L (II. 3); therefore twice the rectangle K H, K L is also equal to twice the square on H K, together with twice the rectangle K H, H L.

Therefore the square on G K is equal to twice the rectangle K H, K L (*Ax.* 1). Q. E. D.

* (17) Through two given points draw two lines which, together with a given line (in position), shall make up an equilateral triangle. (Apply Euc. I. 1 ; I. 31.)

(18) If the opposite sides of a quadrilateral are equal, it is a parallelogram.

(19) To construct a triangle, having given the middle points of each side.

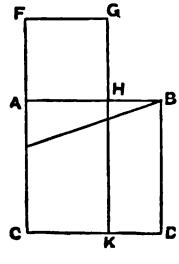
(20) To one of the sides of an equilateral triangle apply an equal parallelogram, having one of its angles equal to that of the given triangle.

* (21) From A C, the diagonal of a square A B C D, cut off A E, equal to one-fourth of A C, and join B E, D E. Show that the figure B A D E equals twice the square on A E.

* (22) Enunciate the proposition which proves that the area of a triangle is represented by half the rectangle which has the same base and altitude. Explain the term gnomon.

* (23) In Euc. II. 11 show that the squares on the whole line and one part are equal to three times the square on the other part.

The figure of Euc. II. 11 is here reproduced.

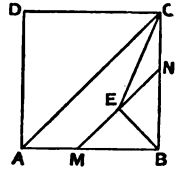


Since the square on A B is equal to the squares on A H, H B, together with twice the rectangle A H, H B (II. 4) ; to each of these equals add the square on H B ; therefore the squares on A B, H B are equal to the square on A H, twice the square on H B, and twice the rectangle A H, H B.

But the square on H B, together with the rectangle A H, H B, is equal to the rectangle A B, H B (II. 3), that is, to the square on A H (*constr.*) ; therefore the squares on A B, H B are equal to three times the square on A H. Q. E. D.

* (24) Divide a straight line into two parts, so that the square on one part shall be double the square on the other part.

Let A B be the given straight line. On A B describe the square A B C D. Join A C. Bisect the angles A B C, B C A by the straight lines B E, C E meeting in E. Through E draw M E N parallel to A C, meeting A B, B C, in M and N. Then A B shall be divided into two parts at the point M as required.



Because E N is parallel to A C, therefore the angle C E N is equal to the angle E C A, that is, to the angle E C N ; therefore E N is equal to C N.

Again, because E M B and E N B are each equal to half a right angle, therefore M B is equal to N B. But A B is equal to C B, therefore A M is equal to C N, that is, to E N.

And, because E N B is equal to E M B, and E B N to E B M, and E B is common to the two triangles E B N, E B M, therefore the angle B E N is equal to the angle B E M ; therefore B E M is a right angle ; also E N is equal to E M.

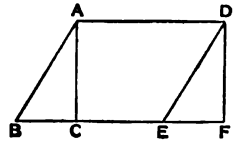
But since E M B is half a right angle, and E B M is half a right angle, therefore E M B is equal to E B M, therefore E M

is equal to E B, and the square on E M is equal to the square on E B.

And because B E M is a right angle, therefore the square on M B is equal to the squares on E M, E B ; that is, the square on M B is double of the square on E M. Also E M is equal to E N, that is, to C N, that is, to A M. Therefore the square on M B is double of the square on A M ; therefore the straight line A B has been divided in M as required.

* (25) If two points be taken on the diameter of a semicircle at equal distances from the centre, and perpendiculars be drawn from them to meet the semicircle, the line joining the points in which the two perpendiculars meet the semicircle will be parallel to the diameter.

* (26) If two triangles have their areas equal, and one side and an adjacent angle equal, each to each, they shall be equal in all respects.



Let A B C, D E F be two triangles, having their areas equal, the side B C equal to the side E F, and the angle A B C equal to the angle D E F. Then these two triangles shall be equal in every respect.

Place the triangles so that B C, E F may be in the same straight line, B F, and the angles A B C, D E F be on the same side of B F. Join A D.

Then, because the equal triangles A B C, D E F are on equal bases, B C, E F ; therefore they are between the same parallels. Therefore A D is parallel to B F (I. 39). Also, because the angle A B C is equal to the angle D E F ; therefore A B is parallel to D E (I. 28).

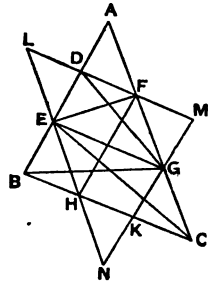
Therefore A B E D is a parallelogram, and the side A B is equal to the side D E (I. 34). And since in the triangles

A B C, D E F, A B is equal to D E, and B C to E F, and likewise the angle A B C is equal to the angle D E F ; therefore the two triangles are equal in every respect (I. 4).

(27) If the sides of a triangle be trisected, and lines be drawn through the points of section adjacent to each angle, so as to form another triangle, this triangle shall be in all respects equal to the first.

Let A B C be a triangle, having its side A B trisected in D, E ; A C in F, G ; B C in H, K. Through D, F ; E, H ; K, G draw L D F M, L E H N, N K G M, meeting and forming the new triangle L N M. The triangle L N M shall be equal to the triangle A B C.

Join D G, E F, E C, B G, E G, F H.



Then the triangle D F E is equal to the triangle D F A (I. 38). Also the triangle G D F is equal to the triangle D F A ; therefore the triangles D F E, G D F are equal ; and they are on the same base D F, therefore D F is parallel to E G (I. 39), therefore the triangle E D G is equal to the triangle E F G (I. 37).

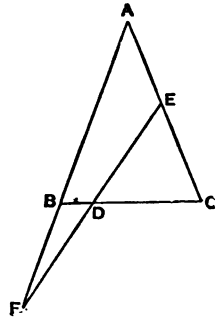
But the triangle E D G is equal to the triangle E G B, and the triangle E F G to the triangle G E C (I. 38), therefore the triangle E G B is equal to the triangle G E C, and they are on the same base, E G ; therefore E G is parallel to B C (I. 39). But D F is parallel to E G, therefore B C is parallel to D F or L M (I. 30).

In the same way it may be proved that A B is parallel to M N, A C to L N, F H to A B, and F H to N M.

Therefore L F is equal to H C (I. 34), F M to H K or B H, and therefore the whole L M is equal to the whole B C. Similarly L N is equal to A C, and N M to A B. Therefore the triangle L N M is equal to the triangle A B C in every respect (I. 8, 4).

* (28) In the base B C of an isosceles triangle take any point D; in C A make C E equal to C D, and let E D cut A B in F. Then will three times the angle A E F be greater than four right angles by the angle A F E.

(We give two proofs of this theorem in an abbreviated form. The pupil should exercise himself in writing them out fully.)



I. Angle A E F = angle E D C + angle E C D
= ½ angle E D C + ½ angle D E C + ½ angle E C D + ½ angle A B C
= 1 rt. angle + ½ angle A B C
∴ 3 angle A E F = 3 rt. angles + angle A B C + ½ angle A C B
= 3 rt. angles + angle A F E + angle B D F + ½ (2 rt. angles − 2 angle E D C)
= 3 rt. angles + angle A F E + angle E D C + 1 rt. angle − angle E D C
= 3 rt. angles + angle A F E + 1 rt. angle
= 4 rt. angles + angle A F E Q. E. D.

II. Angle E D C + angle C E D = 2 rt. angles − angle E C D
$\therefore$ 2 angle E D C = 2 rt. angles − angle E C D
$\therefore$ angle E D C = 1 rt. angle − $\frac{1}{2}$ angle E C D
$\therefore$ angle E D C + angle E C D = 1 rt. angle + $\frac{1}{2}$ angle E C D
$\therefore$ angle A E F = 1 rt. angle + $\frac{1}{2}$ angle A C B
$\therefore$ angle A C B = 2 angle A E F − 2 rt. angles.
But angle A E F + angle A F E = 2 rt. angles − angle B A C
= 2 angle A C B
= 4 angle A E F − 4 rt. angles
$\therefore$ 3 angle A E F = 4 rt. angles + angle A F E.
Q. E. D.

* (29) A line is drawn from an acute angle of a right-angled triangle to the opposite side; prove that the squares on that side and on the line so drawn are together equal to the squares on the hypotenuse and the segment adjacent to the right angle.

* (30) How many sides has a figure if the sum of its interior is double that of its exterior angles?

Let x = No. of sides of the figure.

Then, by Euclid I. 32, Cor. 1;

Sum of interior angles = $2x$ rt. angles − 4 rt. angles.

And, by Euclid I. 32, Cor. 2;

Sum of exterior angles = 4 rt. angles.

But, by the question, the sum of the interior angles is double that of the exterior angles.

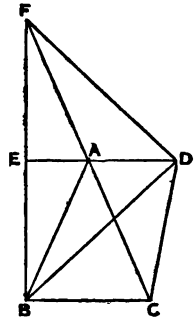
$\therefore$ $2x$ rt. angles − 4 rt. angles = 8 rt. angles.
$\therefore$ $2x$ rt. angles = 12 rt. angles.
$\therefore$ $2x$ = 12
$\therefore$ x = 6 = No. of sides.

* (31) If the straight line joining two opposite angles of a parallelogram bisect them, the parallelogram is a rhombus.

* (32) The perimeter of an isosceles triangle is less than that of any other equal triangle on the same base.

Let A B C be an isosceles triangle, and let D B C be any

other equal triangle on the same base B C and (1) on the same side of it.



Join A D. From B draw B E perpendicular to D A produced (I. 12); produce B E to F, making E F equal to E B. Join A F, F D.

Then E D is parallel to B C (I. 39). The angles F A E and A C B are equal, and so are the angles E A B and A B C (I. 29). Therefore the angles F A E, E A B are equal to the angles A C B, A B C; that is, the angle F A B is equal to the angles A C B, A B C. To each of these equals add the angle B A C; therefore the angles F A B, B A C are equal to the three angles of the triangle A B C; that is, to two right angles. Therefore F A C is one straight line (I. 14).

Again, because F E, E A are equal to B E, E A, each to each, and the angle F E A to the angle B E A, therefore F A is equal A B; that is, to A C. Similarly F D is equal to D B. But F D, D C are together greater than F C; that is, than B A, A C. But F D is equal to D B; therefore D B, D C are together greater than B A, A C. To each of these unequals add B C; then the perimeter of the triangle B D C is greater than that of the triangle A B C.

If the triangle D B C be (2) on the other side of the base B C, draw an isosceles triangle equal and similar to A B C on the other side of the base B C, and the same proof will apply.

* (33) From Euc. II. 7, prove that the sum of the squares on two straight lines is never less than twice their rectangle.

* (34) On the base of a given triangle construct an oblong equal to one fourth of the given triangle.

* (35) Find the number of sides in an equiangular polygon which has four angles together equal to seven right angles.

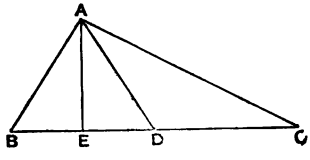
* (36) If from the extremities of any chord in a circle, lines be drawn to any point in the diameter to which it is parallel, the sum of their squares is equal to the sum of the squares on the segments of the diameter.

* (37) The centre of a circle being given, find two *opposite* points in the given circumference by means of a pair of compasses only.

* (38) If the sides of a triangle be as 2, 4, 5, show whether it will be acute or obtuse angled.

* (39) In any triangle the squares on the two sides are together double of the squares on half the base and on the line joining its middle point with the opposite angle.

Let A B C be a triangle, having the base B C. Bisect B C in D; from A draw A E perpendicular to B C, and join A D.



Then the square on A B is less than the squares on B D and A D by twice the rectangle B D, D E (II. 13).

And the square on A C is greater than the squares on C D and A D by twice the rectangle C D, D E (II. 12); that is, than the squares on B D and A D by twice the rectangle B D, D E.

Therefore the squares on A B and A C are together double of the squares on B D and A D.

* (40) A B C is a triangle right-angled at A, and B E, C F bisect the opposite sides respectively. Show that four times

the sum of the squares on B E and C F is equal to five times the square on B C.

* (41) If two adjacent sides of a parallelogram be parallel to two adjacent sides of another parallelogram, the other sides will also be parallel.

(42) Describe an obtuse-angled triangle, such that the square on the largest side may be equal to three times the square on either of the equal sides.

(43) The opposite sides of any equiangular rectilineal figure must be parallel, if the number of sides be even.

(44) Taking the figure of Euclid I. 47, join G H, K E, and D F; then prove that the three triangles G A H, K C E, and D B F are equal, each of them being equal to the triangle A B C.

(45) Trisect a given straight line.

(We give the *construction* of this problem, leaving the *demonstration* to the pupil.)

Let A B be the given straight line; on A B describe the equilateral triangle A B C. Bisect the angles at A and B by the straight lines A D, B D, meeting within the triangle at D. From D draw D E parallel to C A and D F parallel to C B, meeting A B in E and F. The given straight line A B is trisected in the points E and F.

* (46) Given a line divided into two parts, as in Proposition 11 of Book II.; show that the squares on the whole line and one part are equal to three times the square on the other part.

(*See* figure to Euclid II., 11.)

The squares on A B, B H are together equal to twice the rectangle A B, B H, together with the square on A H (II. 7).

But the rectangle A B, B H is equal to the square on A H (II. 11).

Therefore twice the rectangle A B, B H is equal to twice the square on A H.

Therefore the squares on A B, B H are together equal to three times the square on A H.

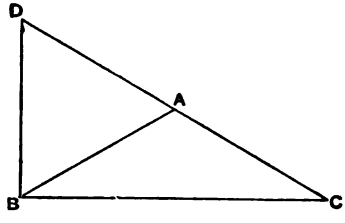
* (47) If D, E, F are points taken in the sides B C, C A, A B

of an equilateral triangle A B C, so that B D = C E = A F, show that the triangle D E F is equilateral.

* (48) If A B C D be a parallelogram, and P any point in the diagonal A C, show that the triangles P B C and P D C are equal.

* (49) From any point P lines are drawn to the angles of a rectangle A B C D; show that the squares on P A, P C are together equal to the squares on P B, P D.

* (50) The base angle of an isosceles triangle is one fourth of the vertical angle, and from it a line is drawn perpendicular to the base to meet the opposite side produced; show that the part produced, the perpendicular, and the remaining side will form an equilateral triangle.



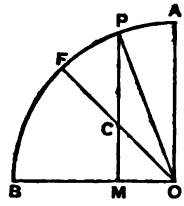
Let A B C be the isosceles triangle. Let the angle A B C be one fourth of the angle B A C. From B draw B D at right angles to B C, meeting C A produced in D. Then D B A shall be an equilateral triangle.

The angle B A C may be proved equal to two-thirds of two right angles. Also each of the angles of the triangle D B A may be proved equal to one-third of two right angles. Hence the triangle is equiangular, and therefore equilateral. (We leave the full demonstration to be worked out by the student.)

* (51) A O B is a quadrant of a circle, whose centre is O, and from any point P in its arc, P M perpendicular to O A or O B meets the radius which bisects the angle A O B in C; show that the squares on P M, C M are together equal to the square on the radius.

Let O F be the radius which bisects the angle A O B. Take

P between F and A. Then P M must be drawn perpendicular to O B. (If P be between F and B, then P M must be drawn perpendicular to O A.)



Join O P. Now prove that M O is equal to M C. Then from the right-angled triangle P M O prove that the squares on P M and C M are equal to the square on P O.

*(52) If straight lines be drawn from each angle of a triangle to bisect the opposite side, four times the sum of the squares on these lines is equal to three times the sum of the squares on the sides.

(*Note.*—Apply Euc. II. 12, 13.)

*(53) The two triangles, formed by drawing lines from any point within a parallelogram to the extremities of two opposite sides, are together half the parallelogram.

*(54) The sum of the squares on the sides of any quadrilateral figure is equal to the sum of the squares on its diagonals, together with four times the square on the line joining the middle points of the diagonals.

In solving this problem it may be assumed that in every triangle the sum of the squares on two of the sides is equal to twice the square on half the base, together with twice the square on the line drawn from the vertex to the middle point of the base. (*See* No. 39.)

MENSURATION.

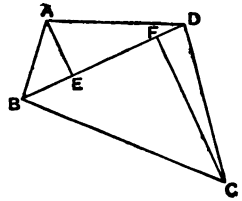
(Continued from Third Year.)

IV. To find the Area of a Trapezium.

A trapezium is a quadrilateral figure none of whose sides are parallel.

Rule.—Multiply the diagonal by the sum of the perpendiculars let fall upon it from the opposite angles, and take half the product for the area.

Proof.—Let A B C D be a trapezium, of which B D is a diagonal, and A E, C F are perpendiculars falling on B D from the angles A and C.



$$\text{Then area A B C D} = \frac{\text{B D (A E + F C)}}{2}$$

$$\text{For area triangle A B D} = \frac{\text{B D} \times \text{A E}}{2}$$

$$\text{And area triangle } BDC = \frac{BD \times FC}{2}$$

$$\therefore \text{ Area trapezium } ABCD = \frac{BD \times AE}{2} + \frac{BD \times FC}{2}$$

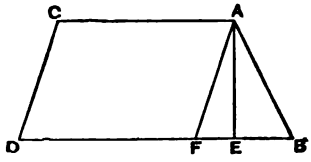
$$= \frac{BD \times AE + BD \times FC}{2}$$

$$= \frac{BD(AE + FC)}{2}$$

V. To find the Area of a Trapezoid.

A trapezoid is a quadrilateral figure having two only of its sides parallel.

Rule.—Multiply the sum of the two parallel sides by the perpendicular distance between them, and take half the product for the area.



Proof.—Let A C D B be a trapezoid, having the two sides C A, D B parallel; let A E be the perpendicular from A on D B.

$$\text{Then area } ACDB = \frac{AE(AC + DB)}{2}$$

Through A draw A F parallel to C D.

Then A C D F is a parallelogram.

$$\text{Area parallelogram } ACDF = AC \times AE$$

$$\text{And area triangle } AFB = \frac{FB \times AE}{2}$$

$$\therefore \text{ Area trapezoid } ACDB = (AC \times AE) + \frac{FB \times AE}{2}$$

$$= AE\left(AC + \frac{FB}{2}\right) = AE\left(\frac{2AC + FB}{2}\right)$$

$$= AE\left(\frac{AC + DF + FB}{2}\right) = \frac{AE(AC + DB)}{2}$$

Sometimes the term *trapezium* is used to denote generally

any quadrilateral figure which is not a parallelogram, and then the term *trapezoid* is not required.

Exercise 1.

(1) Find the area of a trapezium whose diagonal is 42 and tne perpendiculars 18 and 16 respectively.

$$\text{Area trapezium} = \frac{42\,(18 + 16)}{2} = 714.$$

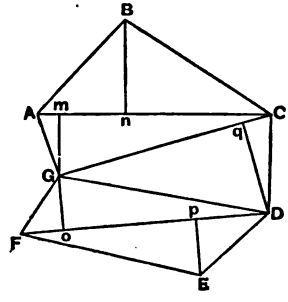
(2) In a trapezoid the parallel sides are 7·5 and 12·25 chains, the perpendicular distance between them is 15·4 chains; find the area.

$$\text{Area trapezoid} = \frac{15{\cdot}4\,(7{\cdot}5 + 12{\cdot}25)}{2} = 152{\cdot}075 \text{ chains.}$$

10) 152·075 sq. chains
15·2075 acres.
4
·8300 roods
40
33·20 perches.

Area = 15a. or. 33·2p.

(3) Find the area of the irregular figure A B C D E F G,



having given A C = 5·5; F D = 5·2; G C = 4·4; G m = 1·3; B n = 1·8; G o = 1·2; E p = ·8; D q = 2·3.

$$\text{Area A B C G} = \frac{5{\cdot}5\,(1{\cdot}8 + 1{\cdot}3)}{2} = 8{\cdot}525$$

$$\text{Area G D E F} = \frac{5{\cdot}2\,(1{\cdot}2 + {\cdot}8)}{2} = 5{\cdot}2$$

$$\text{Area G D C} = \frac{4{\cdot}4 \times 2{\cdot}3}{2} = 5{\cdot}06$$

$\therefore$ Area A B C D E F G $= 8{\cdot}525 + 5{\cdot}2 + 5{\cdot}06 = 18{\cdot}785$

(4) What is the area of a trapezium whose diagonal is $108\frac{1}{2}$ feet, and the perpendiculars $56\frac{1}{4}$ and $60\frac{3}{4}$ feet?

(5) The sides of a trapezium A B C D are A B = 15, B C = 13, C D = 14, A D = 12; the diagonal A C is 16. Find the area.

Here we have two triangles, in each of which the three sides are given.

(6) Find the area of a trapezoid, the parallel sides being 21ft. 3in., and 18ft. 6in., and the perpendicular distance between them 8ft. 6in.

Note.—The following are selected from previous Examination Papers.

(7) In surveying a four-sided field, A B C D, I measure A C = 190 feet, and perpendiculars from the other corners upon A C = 45 feet and 60 feet respectively. Find its area.

(8) Find the area (in square chains) of a quadrilateral figure, of which two parallel opposite sides are respectively 750 links and 1225 links, and the perpendicular distance between these sides is 1540 links.

(9) Two parallel sides of a four-sided field are respectively 14 and 20 yards, and the perpendicular distance between them is 12 yards. What is its area?

(10) If a field have two parallel sides, the sum of which is 1025 links, while the perpendicular distance between them is 310 links, what is the acreage of the field?

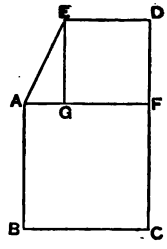
(11) Find the area of a field having two parallel sides 650 and 925 links long, the perpendicular distance between the sides being 840 links.

(12) A B C D is a quadrilateral field, A B measures 48 chains, B C 20 chains, the diagonal A C 52 chains, and the perpen-

dicular from D on A C 30 chains. Find the acreage of the field.

(13) The area of a trapezoid is 762·24 sq. ft., and the sum of the parallel sides is 158·8 feet; find the distance between them.

(14) A B C D E is a five-sided field, and the angles at B, C, D are right angles; A B = 20 feet, B C = 18 feet, C D = 32 feet, D E = 13 feet. Find the length of remaining side and area of the field.



Draw A F parallel to B C, and E G parallel to D C. Then

$$E G = D F = DC - F C$$
$$= D C - A B = 12$$
$$\text{And } A G = A F - G F = B C - E D = 5.$$

Then, since A G E is a right angle, A E can be found from E G and A G.

Area of field = area rectangle A B C F + area trapezoid A F D E.

(15) Two of the four sides of a field are parallel and differ by 4 feet in length. Find them, their perpendicular distance being 19 feet and the area of the field 475 square feet.

VI. To find the Area of a Regular Polygon.

A regular polygon is a rectilineal figure contained by any number of equal sides, and having all its angles equal. Properly speaking, the term is only applied to figures with more than *four* equal sides; but in its widest signification it includes the equilateral triangle and square.

A regular polygon of five sides is called a pentagon.

" " six " " hexagon.

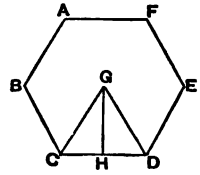
" " seven " " heptagon.

" " eight " " octagon.

So we have the terms nonagon, decagon, etc., for nine, ten, and more sides.

Rule.—Multiply the perimeter, or sum of the sides, by the perpendicular let fall on one of the sides from the centre of the polygon, and take half of the product for the area.

By the centre of the polygon is meant the centre of the inscribed and described circles.



Proof.—Let A B C D E F be a hexagon; let G be the centre. From G draw G H perpendicular to C D. Then the perimeter is 6 C D,

$$\text{and area hexagon} = \frac{6\,C\,D \times G\,H}{2}$$

$$\text{For area triangle } G\,C\,D = \frac{C\,D \times G\,H}{2}$$

And if we join G B, G A, G F, G E, it is evident that the hexagon is made up of six triangles, each equal to G C D.

$$\therefore \text{ Area hexagon} = 6 \text{ times area triangle } G\,C\,D.$$

$$= \frac{6\,C\,D \times G\,H}{2}$$

The same proof will apply to any regular polygon, so that if a = length of one side, n = number of sides, and p = perpendicular from the centre on one of the sides,

$$\text{Then area polygon of } n \text{ sides} = \frac{n\,a\,p}{2}$$

The area may be found from the side alone, thus: Multiply

the square of the side by the multiplier set against its name in the following table, which should be used for reference. The proof depends on Trigonometry.

No. of Sides.	Name.	Ratio of Area to Square of Side.
3	Trigon, or Equilateral Triangle	·4330127
4	Tetragon, or Square.	1·0000000
5	Pentagon	1·7204774
6	Hexagon	2·5980762
7	Heptagon	3·6339124
8	Octagon	4·8284271
9	Nonagon	6·1818242
10	Decagon	7·6942088
11	Undecagon	9·3656399
12	Dodecagon	11·1961524

Conversely, the side may be found from the area.

Exercise 2.

(1) Find the area of a regular pentagon whose side is 25 ft., and perpendicular from the centre 17·204774 ft.

(2) Find the area of an octagon whose side is 12 yds., and perpendicular from the centre 14·4852816 yds.

(3) Find the area of an octagon whose side is 20.

(4) Find the area of a decagon whose side is 20.

Note.—The following are selected from Government Examination Papers.

(5) Find the area of a regular hexagon inscribed in a circle whose radius is 50 feet.

From Euc. IV. 15, it appears that if lines be drawn from the centre of a hexagon to each of its angles, these lines divide it into six equilateral triangles.

Hence the area of the hexagon may be obtained by finding the area of one of these equilateral triangles and then multiplying by six. (*See* Chap. III.)

(6) What is the length of a side of the heptagon which has an area of 1364·84 yds.?

(7) What is the length of the side of the octagon whose area is 30·1776 sq. ft.?

VII. To find the Circumference of a Circle, the Diameter or Radius being given.

The circumference of a circle is proved by Trigonometry to bear a fixed ratio to its diameter. This ratio is denoted by the Greek letter π (Pi), and is equal to $\frac{22}{7}$ nearly, or 3·1416 nearly.

Hence we have the following Rule.

Rule.—Multiply the diameter by 3·1416, and the product will be the circumference.

If the radius be given, the diameter is found by multiplying it by 2.

Conversely, the diameter of a circle can be found by *dividing* the circumference by 3·1416.

Exercise 8.

(1) Find the circumference of a circle whose diameter is 30 ft.

$$\text{Circumference} = 30 \text{ ft.} \times 3{\cdot}1416$$
$$= 94{\cdot}248 \text{ ft.}$$

(2) Find the radius of a circle whose circumference is 50 yards.

Circumference = 50 yds.

$\therefore$ Diameter = 50 yds. $\div$ 3·1416 = 15·9154 yds.

$\therefore$ Radius = 15·9154 yds. $\div$ 2 = 7·9577 yds.

(3) The diameter of the earth being taken at 7,958 miles, what is the circumference?

Note.—The following are taken from Government Examination Papers.

(4) What is the diameter of a coach-wheel that makes 600 revolutions in travelling a mile?

(5) How many shrubs placed 3 yards apart can be planted

round the edge of a semicircular lawn the radius of which is 144 ft. ?

Since a circle contains 360 degrees (360°) and each degree contains 60 minutes (60′), the length of any arc may be found if the diameter (or radius) of the circle be given.

(6) Find the length of an arc of 50 degrees, if the diameter of the circle be 30 feet.

$$\begin{aligned} \text{Circumference of circle} &= 30 \text{ ft.} \times 3{\cdot}1416 \\ &= 94{\cdot}248 \text{ ft.} \\ \text{Length of } 360° &= 94{\cdot}248 \text{ ft.} \\ \therefore \text{ Length of arc of } 50° &= 94{\cdot}248 \text{ ft.} \div 360 \times 50 \\ &= 13{\cdot}09 \text{ ft.} \end{aligned}$$

The Rule of Three may be employed in examples of this kind, thus :—

360° : 50° :: 94·248 ft. : Answer.

(7) Find the length of an arc of 30°, the radius of the circle being 5 ft.

(8) The length of an arc of 90° being 4·7124 miles, find the radius of the circle.

(9) If the diameter of a circle be 15 yards, find the length of an arc of 22° 30′.

(10) The length of an arc of 14° 24′ being 12 ft., find the diameter of the circle.

VIII. To find the Area of a Circle.

Rules.—(*a*) Multiply half the circumference by half the diameter, and the product will be the area required.

(*b*) Multiply the square of the diameter by ·7854, and the product will be the area.

Proof.—These rules can only be fully proved by Trigonometry. It may, however, be observed that Rule (*a*) is similar to that for finding the area of a regular polygon. A circle may be regarded as a regular polygon with an infinite number of sides. Then the perimeter is the circumference of the circle, and the perpendicular on one of the sides is the radius of the circle.

Rule (*b*) may be deduced from Rule (*a*), thus:—

By Rule (*a*), area circle $= \frac{1}{2}$ diam. $\times \frac{1}{2}$ circum.

$= \frac{1}{2}$ diam. $\times \frac{1}{2}$ (diam. $\times$ 3·1416)

$= \frac{1}{2}$ diam. $\times \frac{1}{2}$ diam. $\times$ 3·1416

$= \frac{1}{4}$ (diam.)$^2 \times$ 3·1416

$= (\text{diam.})^2 \times \frac{3 \cdot 1416}{4}$

$= (\text{diam.})^2 \times \cdot 7854$

Exercise 4.

(1) Find the area of a circle whose diameter is 10.

Here diameter $= 10$

$\therefore$ Circumference $= 31 \cdot 416$

$\therefore$ By Rule (*a*) area $= \frac{10}{2} \times \frac{31 \cdot 416}{2} = 73 \cdot 54$

Or, by Rule (*b*) area $= 10^2 \times \cdot 7854 = 78 \cdot 54$

(2) What is the area of a circle whose diameter is 7 yards and circumference 22 yards?

(3) Find the area of a circle whose diameter is 7

(4) Find the area of a circle whose circumference is 40·8408 yards.

(5) Find the area of a circle whose radius is 3 miles.

(6) Find the diameter and radius of a circle whose area is 63·6174 sq. yds.

Area $= 63 \cdot 6174$ sq. yds.

$\therefore$ (diam.)$^2 \times \cdot 7854 = 63 \cdot 6174$ sq. yds.

$\therefore$ diam.$^2 = 63 \cdot 6174 \div \cdot 7854$

$= 81$ yds.

$\therefore$ diam. $= 9$ yds.

$\therefore$ radius $= 9$ yds. $\div 2 = 4\frac{1}{2}$ yds.

(7) The area of a circle is 153·9384 inches; what is the radius?

Note.—The following are selected from Government Examination Papers.

(8) Find the diameter of a circular surface 6·68135 square feet in area.

(9) Find the area, in sq. yards, of a circle of 72 feet radius.

(10) What must be the diameter of a circular lawn in order that it may contain a quarter of an acre?

(11) Find the area of a circle whose diameter is 48 yards.

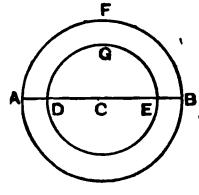
(12) A room 25 ft. 3 in. long, 14 ft. 6 in. wide, has a semicircular bow 21 ft. in diameter thrown out on one side; find the area of the whole room.

(13) The sides of a right-angled triangle are 70 ft. and 98 ft.; find, in sq. ft., the area of the semicircle described on the hypotenuse.

(14) The sides of a triangle are 13, 14, and 15 feet. Find the area of the circle which has the same perimeter.

To find the area of a circular ring, or space included between two concentric circles, it is only necessary to subtract the area of the smaller from that of the larger circle.

(15) Find the area of the circular ring between the circles A F B and D G E, A B being 10 ft., and D E 6 ft.



Area larger circle $= 10^2 \times \cdot 7854$
$= 78 \cdot 54$ sq. ft.

Area smaller circle $= 6^2 \times \cdot 7854$
$= 28 \cdot 2744$ sq. ft.

$\therefore$ Area circular ring $= 78 \cdot 54 - 28 \cdot 2744$ sq. ft.
$= 50 \cdot 2656$ sq. ft.

Or thus;

Area ring $= 10^2 \times \cdot 7854 - 6^2 \times \cdot 7854$
$= (10^2 - 6^2) \times \cdot 7854$
$= (10 + 6)(10 - 6) \times \cdot 7854$
$= 16 \times 4 \times \cdot 7854 = 50 \cdot 2656$ sq. ft.

Thus generally, if a = longer diameter, and b = shorter diameter—

$$\text{Area ring} = a^2 \times \cdot7854 - b^2 \times \cdot7854$$
$$= (a^2 - b^2) \times \cdot7854$$
$$= (a + b)(a - b) \times \cdot7854$$

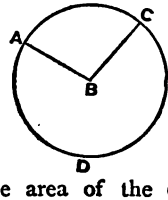
Hence the following rule:—Multiply the sum of the diameters by their difference, and their product by ·7854; the last product will be the area of the circular ring.

(16) Find the area of the circular ring between the circles whose diameters are 6 and 4 yards.

(17) Find the area of a gravel walk 5 ft. wide which surrounds a circular pond 155 ft. in diameter.

IX. To find the Area of a Sector of a Circle.

Definition.—A sector of a circle is a part of a circle bounded by an arc and two radii drawn to its extremities. Thus, in the next figure, A B C is a sector of the circle A C D, bounded by the arc A C and the radii A B, B C.



Rules.—(*a*) Find the area of the circle, multiply by the number of degrees in the arc, and divide by 360.

(*b*) Multiply half the length of the arc by the radius.

If the length of the arc be not given, it can be found by the method explained in chapter VII.

Proof.—(*a*)

Let A = area of the whole circle
and n = No. of degrees in the arc.

$$\text{Then area sector of } 1^\circ = \frac{A}{360}$$

$$\therefore \text{ area sector of } n^\circ = \frac{An}{360}$$

which is the algebraical expression for the rule.

(*b*) By Euc. VI. 33, sectors of a circle have to each other the same ratio as the arcs on which they stand. Therefore the area of a sector of a circle is to the area of the circle as the arc of the sector is to the circumference of the circle.

Let r = radius of the circle, m = length of the arc. Then area of circle = $(2r)^2 \times \cdot 7854$; and circumference of circle = $2r \times 3\cdot1416$.

$$\text{Area sector} : 2r^2 \times \cdot 7854 :: m : 2r \times 3\cdot1416$$

$$\therefore \text{area sector} = \frac{(2r)^2 \times \cdot 7854 \times m}{2r \times 3\cdot1416}$$

$$= \frac{2r \times m}{4} = \frac{r \times m}{2}$$

which is the algebraical expression for the rule.

Exercise 5.

(1) The arc of a sector contains 25°, the diameter of the circle is 5 yards. Find the area of the sector.

Here area circle = $5^2 \times \cdot 7854 = 19\cdot635$ square yards

$\therefore$ area sector $1° = 19\cdot635 \div 360$

$\therefore$ area sector $25° = 19\cdot635 \div 360 \times 25$

$= 1\cdot363541$ square yards.

(2) The radius of a sector is four feet, the length of the arc is 6 feet; what is the area of the sector?

By rule (*b*), area sector = $3 \times 4 = 12$ square feet.

(3) The arc of a sector is 18°, and the diameter 3 feet. Find the area.

(4) What is the area of a sector whose arc is 20 yards and radius 10 yards?

(5) The arc is 13 inches and radius 13 inches; find the area of the sector.

(6) Find the area of a sector whose radius is 25 feet, and whose arc contains 147° 29′.

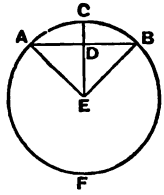
(7) Find the area of a quadrant which has a radius of 1 foot 6 inches.

(8) Find the area of a sextant which has a radius of 12 inches.

(9) The area of a sector being 125 square feet, and of the whole circle 400 square feet; find the angle of the sector.

X. To find the Area of a Segment of a Circle.

Definition.—A segment is a part of a circle bounded by an arc and its chord. Thus, in the next figure, A C B is a segment of the circle A F B, bounded by the arc A C B and the chord A B.



Rule.—Find the area of the sector having the same arc as the segment. Find also the area of the triangle formed by the chord of the segment and the two radii of the sector. Subtract the latter area from the former, when the segment is less than a semi-circle; add the two areas together, when the segment is greater than a semi-circle.

Proof.—Thus, if E be the centre of the circle, join E A, E B. Then, if the segment A C B be less than a semicircle, the centre will be without the segment, and

Area segment A C B = area sector A E B C − area triangle A E B.

Similarly, in the segment A F B, which is greater than a semicircle, the centre will be within the segment, and

Area segment A F B = area sector A F B E + area triangle A E B.

The area of a segment of a circle cannot, however, be conveniently found without the aid of Trigonometry.

Exercise 6.

(1) Find the area of the segment A E B, when the radius A E is 10, the arc 90°, the chord A B 14·142, and the perpendicular E D from the centre on the chord A B 7·071.

(The area can be found by Trigonometry from the radius and arc alone.)

The segment is greater or less than a semi-circle, according as the arc is greater or less than 180°.

Here the segment is less than a semi-circle.

Area circle $= 20^2 \times \cdot 7854 = 314 \cdot 16$

$\therefore$ Area sector $90° = 157 \cdot 08 \div 4 = 78 \cdot 54$

Area triangle A E B $= 14 \cdot 142 \times 7 \cdot 071 \div 2 = 49 \cdot 999$

$\therefore$ Area segment $= 78 \cdot 54 - 49 \cdot 999 = 28 \cdot 541$

(2) Find the area when the radius is 12, the arc 60°, the chord 12, and the perpendicular on the chord 10·39.

(3) Find the area when the radius is 15, the arc 120°, the chord 26, and the perpendicular on the chord 7·5.

(4) Find the area when the radius is 25 feet, the arc 80°, the chord 32·12 feet, and the perpendicular on the chord 19·15 feet.

(5) Find the area when the radius is 8 yards, the arc 300°, the chord 8 yards, and the perpendicular on the chord 6·9 yards.

(6) Find the area when the radius is 5 inches, the arc 240°, the chord 4·33 inches, and the perpendicular on the chord 2·5 inches.

The following additional rules may be given, though they do not properly belong to the Government Course for Pupil Teachers.

1. To Find the Area of an Ellipse.

Multiply the product of the two diameters by ·7854.

2. To Find the Area of the Convex Surface of a Cylinder.

Multiply the circumference by the length of the cylinder. The convex surface of the cylinder forms a rectangle.

3. To Find the Convex Surface of a Right Cone.

Multiply the circumference of the base by the slant height, and take half the product for the surface. The convex surface of a right cone forms a sector of a circle.

4. To Find the Convex Surface of a Sphere or Globe.

(*a*) Multiply the circumference by the diameter.

(*b*) Multiply four times the square of the radius by 3·1416.

(*c*) Multiply the square of the diameter by 3·1416.

Exercise 7.

MISCELLANEOUS EXAMPLES.

The following examples are selected from Examination Papers for Pupil Teachers and Queen Scholarships. The solutions which are given are not intended to be used until the pupil has endeavoured to work out the examples for himself.

(1) Each side of a rhombus is 65 feet, and one of the diagonals is 104 feet; find the area in square feet.

(2) The diameter of a circle is 12 feet; find the area of a square inscribed in it.

(3) If the perimeter of a semi-circular flower-bed be 60 feet, how many plants will it contain, allowing one square foot for each plant?

The perimeter = diameter of circle + half-circumference.

Let x = diameter of circle

$\therefore$ half circumference $= \frac{3{\cdot}1416}{2} x$

$\therefore x + \frac{3{\cdot}1416}{2} x = 60$ feet

$\therefore 5{\cdot}1416x = 120$ feet

$\therefore x = 23{\cdot}339$ feet

$\therefore$ Area whole circle $= (23{\cdot}339)^2 \times {\cdot}7854$

$= 427{\cdot}8143$ square feet

$\therefore$ Area flower-bed $= 427{\cdot}8143$ square feet $\div 2$

$= 213{\cdot}907$ square feet

$\therefore$ No. of plants = 213, or 214 nearly.

(4) Write out the table of square measure, and calculate how many square yards there are in a farm which covers 1 square mile, 30 acres, and 6 square chains.

(5) A man undertook to walk round a square field containing 13 acres 1089 yards, in 7 minutes. If his pace was on the average 5 miles an hour, by how much time did he win?

(6) A window in the form of a square with a semi-circular head contains 41½ square feet; what is its extreme height?

Let x = the side of the square in feet
Then x = diameter of semi-circle
$\frac{1}{2}x$ = radius of „
and $x + \frac{1}{2}x$ = extreme height of window
x^2 = area of the square
$\frac{1}{2}(x^2 \times \cdot 7854)$ = area of semi-circle
$\therefore x^2 + \frac{1}{2}(x^2 \times \cdot 7854)$ = area of window = $41\frac{1}{4}$ square feet
$\therefore 1\cdot 3927x^2 = 41\cdot 142857$ square feet
$\therefore x^2 = 29\cdot 541794$ square feet
$\therefore x = 5\cdot 435$ feet
$\therefore x + \frac{1}{2}x = 8\cdot 152$ feet = 8 feet 1·8 + in.

(7) The distance between two places on a map drawn on the scale of $\frac{1}{8}$ of an inch to a mile, is 5 ft. $2\frac{1}{2}$ in. Find the real distance.

(8) A barn is 60 feet long, and 30 feet wide, and 20 feet high, measured perpendicularly from the level of the eaves. How many square feet of slating does it contain?

(9) A four-sided field, A B C D, is measured by a chain from each corner to the corner opposite. A C is found to be 10 chains 11 links, and B D 11 chains 10 links; A C and B D are at right angles to each other. What does the field measure in *a. r. p.*?

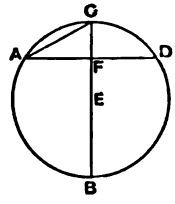
Note.—Either of the diagonals may be regarded as the sum of the perpendiculars on the other diagonal.

(10) In the middle of a circular court 30 ft. in diameter is a well in the form of a regular hexagon, each side of which is 2 feet. Find the expense of paving the court at 2*s.* 3*d.* per square foot.

(11) Find the length of an arc whose chord is 24 and height 5 ft.

Let A C D be the arc, A D the chord; then A C is half the arc. Join A C, then the straight line A C is the chord of half the arc.

$$\begin{aligned} A C^2 &= A F^2 + C F^2 \\ &= 12^2 + 5^2 = 169 \\ \therefore A C &= 13. \end{aligned}$$



Having now the chord of half the arc, the length of the arc may be found by the following rule (proved by Trigonometry).

From eight times the chord of half the arc, subtract the chord of the whole arc, and take one-third of the remainder for the length of the arc nearly.

(12) Find the ratio of the area of a circle to the area of a regular hexagon which has the same perimeter.

$$\begin{aligned}
\text{Let } x &= \text{diameter of the circle.}\\
\text{Then } 3{\cdot}1416\,x &= \text{circumference of the circle}\\
\text{and } 3{\cdot}1416\,x &= \text{perimeter of hexagon.}\\
\therefore {\cdot}5236\,x &= \text{side of hexagon.}\\
\text{Area circle} &= x^2 \times {\cdot}7854\\
\text{Area hexagon} &= \text{area six equilateral triangles with side } {\cdot}5236\\
&= 6({\cdot}5236)^2x^2 \times {\cdot}433\\
\therefore \text{ratio} &= \frac{x^2 \times {\cdot}7854}{6({\cdot}5236)^2x^2 \times {\cdot}433} = \frac{{\cdot}7854}{{\cdot}7122}\\
&= 7854 : 7122.
\end{aligned}$$

(13) The difference between the areas of two squares inscribed and circumscribed about a circle is 338 ft. Find the radius of the circle.

(14) Find the perpendicular distance between the parallel sides of a trapezoid whose area is $3\frac{3}{4}$ acres, the sum of the parallel sides being 11 chains.

(15) How many turns does a wheel, whose radius is 14 inches, make in travelling 4,000 links?

(16) A mirror measuring 33 inches by 22 is to have a frame

of uniform width, whose area is to be equal to that of the glass. Find the width.

(17) The sides containing the right angle of a triangle are 9 feet and 12 feet; prove that the areas of the equilateral triangles described on them are together equal to the area of the equilateral triangle described on the hypotenuse.

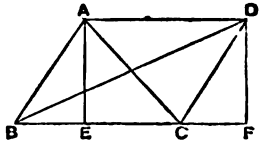
(18) A circle is described about a square whose side is 6 yards; what part of a square chain is the area between the square and the circle?

(19) Find the diameter of a circle which is less than the circumference by 10 feet.

(20) A railway platform is 54 yards long, 21 yards broad. How many planks does it contain, each being $13\frac{1}{3}$ feet long and $1\frac{43}{155}$ links wide?

(21) Find the area of a triangle whose sides are 319 ft., 444 ft., and 455 ft.

(22) Given two contiguous sides of a parallelogram, and one of its diagonals; show how the other diagonal may be found.



Let A B C D be a parallelogram, of which the two sides A B, A D and the diagonal A C are given. Then the other diagonal B D may be found thus :—

Since we have the sides A B, A D, we have also the other sides B C, C D (Euc. I. 34).

Hence in the triangle A B C we have the three sides, and can find the area by the formula $\sqrt{s(s-a)\ (s-b)\ (s-c)}$. Thus area triangle A B C is known.

From A draw A E perpendicular to B C, and from D draw D F perpendicular to B C produced.

Then, since we have the area of the triangle A B C, and the

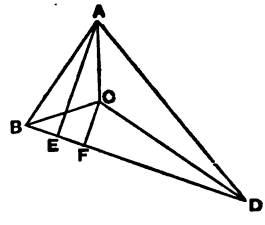
base B C, we can find the perpendicular height A E or D F; for area triangle A B C $= \frac{1}{2}$ B C $\times$ A E, and therefore A E or D F = area triangle A B C $\div \frac{1}{2}$ B C.

Then, since we have D C and D F, we can find C F from the formula $CF^2 = DC^2 - DF^2$.

Then B F = B C + C F, and $BD^2 = BF^2 + FD^2$, and therefore B D $= \sqrt{BF^2 + FD^2}$.

(23) The radius of a circle is $17\frac{1}{2}$ feet; find the area of a sector which contains 24° 25′.

(24) One diagonal of a quadrilateral, which lies outside the figure, is 70 feet; and the difference of the perpendiculars upon it from the extremities of the other diagonal is 16 feet. Find the area.



Let A B C D be the quadrilateral.

Join A C, B D. Then B D is the diagonal outside the figure, and A C is the other diagonal.

From A, C, draw A E, C F, perpendicular to B D.

Let x = C F; then $x + 16$ = A E

Area triangle A B D $= 70 \times \frac{1}{2}(x + 16)$

Area triangle B C D $= 70 \times \frac{1}{2} x$

$\therefore$ Area quadrilateral A B C D $= 70 \times \frac{1}{2}(x + 16) - 70 \times \frac{1}{2} x$.

$= 35x + 560 - 35x$

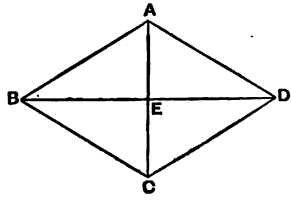
$= 560$ square feet.

(25) If the string of a kite, being 150 yds. long, is curved into a semicircle, what is the actual distance from the kite to the hand of the holder of the string?

(26) A four-sided field contains 40 acres; all the sides are

equal, and one diagonal is twice as long as the other ; find the length of a side in yards.

Let A B C D be the field; join B D, A C; let B D be the



longer, and A C the shorter diagonal; let the diagonals cut one another at E.

Then, because B A, A D, B D are equal to B C, C D, B D, each to each; therefore the triangle B A D is equal to the triangle B C D (Euc. I. 8, 4), and the diagonal B D bisects the figure A B C D.

In like manner it may be shown that the diagonal A C bisects the figure A B C D.

Therefore the triangle A D B is equal to the triangle A C B;

therefore B A is parallel to C D (Euc. I. 39).

Similarly, A D is parallel to B C;

therefore A B C D is a parallelogram (rhombus).

Again, because B A is equal to A D, therefore the angle A B E is equal to the angle A D B (Euc. I. 5); but the angle A D B is equal to the angle E B C (Euc. I. 29), therefore the angle A B E is equal to the angle E B C.

Also, in the triangles A B E, E B C, the two sides A B, B E are equal to the two sides B C, B E, each to each; therefore A E is equal to C E, and the angle B E A is equal to the angle B E C (Euc. I. 4); therefore B E is at right angles to A C, and B D bisects A C at right angles.

Similarly, A C cuts B D at right angles.

Let A E $= x$; then A C $= 2x$, and B D $= 4x$.

Area triangle A B D $= \frac{1}{2}$ area parallelogram A B C D
$= 20$ acres
$= 20 \times 4840$ sq. yds.
Also area triangle A B D $= \frac{1}{2}$ (A E $\times$ B D)
$= \frac{1}{2}(x \times 4x) = 2x^2$
$\therefore 2x^2 = 20 \times 4840$ sq. yds.
$\therefore x^2 = 48400$
Square of side A D = square of side A E + square of side E D
$= x^2 + 4x^2$
$= 5x^2$
$\therefore$ side A D $= \sqrt{5x^2} = \sqrt{5 \times 48400}$
$= \sqrt{242000}$
$= 491{\cdot}934 +$ sq. yds.

(27) The sides of a triangle are 51 ft., 68 ft., and 85 ft.; show that it is right angled, and that the ratio of the areas of the triangles into which it is divided by a perpendicular from the right angle on the hypotenuse is 9 : 16.

(28) The sides of a rectangle are 16 and 24 ft.: what length of border must be taken off all round that the remaining area may be 240 square feet?

(29) The shape of a plate-glass mirror is a semicircle on a square whose side is 5 feet; find its cost at 6·2 shillings per square foot.

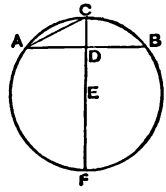
(30) The cost of trenching a square garden whose side is 71 yds. is £57 15*s.* $2\frac{1}{4}$*d.*; how much is that per square yard?

(31) In a five-sided yard, A B C D E, I note the following measurements: A B = 14; B C = 7; C D = 10; D E = 12; E A = 5; A C = 17, all in chains. Also the angle at E is a right angle. Find the area.

(32) Give the rules (1) For finding the area of a triangle when the three sides are known; (2) For finding the diameter of a circle when the height of an arc and the chord of half the arc are known; (3) Simpson's rule for finding the area of a figure bounded by straight lines and a curve.

(*a*) The diameter may be found thus :—

Let A F B be a circle, A B the chord of the arc A C B, C D the height of the arc, and A C the chord of half the arc.



Then the square on A D is equal to the difference of the squares on A C and C D. Hence we can find A D, which is equal to D B.

By Euc. III. 35 the rectangle C D, D F is equal to the rectangle A D, D B, that is, to the square on A D.

Hence, if A D contain a units, and C D b units of length,

and length of D F $= x$

Then $b \times x = a^2$

$$\therefore x = \frac{a^2}{b}$$

And diameter $= b + x$

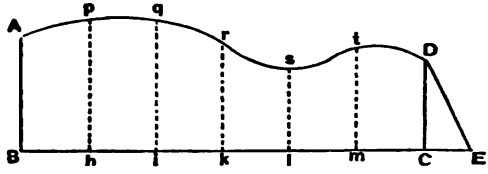
$$= b + \frac{a^2}{b}$$

The rule may be stated thus : From the square of the chord of half the arc subtract the square of the height of the arc, the remainder will be the square of half the chord of the whole arc. Divide this square by the height of the arc, and add the quotient to the height of the arc.

(*b*) **Simpson's Rule** may be explained thus :—

Let A B C D be an irregular figure, having the curved side A D. Let A B be parallel to D C. Divide B C into a number of equal parts at h, i, k, l, m ; draw hp, iq, kr, ls, mt, parallel to A B or D C. If now we add together all the breadths B A, hp, iq, etc., and divide the sum by the number of breadths, the

quotient will give the *average breadth* of the figure. This average breadth multiplied by the length B C will give an approximation to the area of the figure.



It is evident that the greater the number of equal parts into which the side B C is divided, the more correct will be the answer obtained.

If the figure be A B E D, in which D E is not parallel to A B, the area of A B C D may be found as before; the whole area will then be obtained by adding that of the triangle D C E.

Simpson's Rule is generally stated thus:—Take the breadth in several places, at equal distances, and divide the sum of the first and last of them by 2 for the arithmetical mean between those two. Then add together this mean and all the other breadths, omitting the first and last, and divide their sum by the number of parts so added, which will give a medium breadth for the whole; then multiply the quotient by the length for the area, nearly.

Or simply, add all the breadths together, and divide the sum by the number of them for an average breadth, and multiply the quotient by the length for the area, nearly.

If the breadth be not taken at *equal* distances, then it is necessary to compute the area of each trapezoid separately.

The breadths B A, *h p*, *i q*, etc., are generally called *ordinates*.

(33) A triangular field, whose sides are 350, 440, and 750 yards, is let for £26 5*s*. a year. What is that per acre?

(34) Find the diameter of a circle whose circumference is a furlong.

(35) The area of an equilateral triangle is 100 square feet; find its perimeter in yards.

(36) A planet being supposed to describe a circle of 37 million miles' radius round the sun in 88 days, find the number of miles described in a second.

(37) Find the side of a square inscribed in a semicircle whose radius is 5 feet.

(38) A yard, whose area is 810 square feet, is to be paved with 1080 rectangular tiles; find the breadth (which is three-quarters of the length of each tile).

(39) Required the pressure (to the nearest hundred-weight) on a circular plate 3 feet in diameter, the pressure on a square inch being 15 lbs.

(40) The length of an arc being given, how do you find the number of degrees in the angle subtended by the arc at the centre?

(41) The sum of the perimeter and the diagonal of a square being 6 feet, find its side.

Let x = length of side in feet

$\therefore 4x$ = perimeter

and $\sqrt{2x^2}$ = diagonal

$\therefore 4x + \sqrt{2x^2} = 6$

$\therefore 4x + x\sqrt{2} = 6$

$\therefore x(4 + \sqrt{2}) = 6$

$$\therefore x = \frac{6}{4+\sqrt{2}} = \frac{6}{4+1{\cdot}414}$$

$$= \frac{6}{5{\cdot}414} = 1{\cdot}1082 +$$

(42) A diagonal of a four-sided field is 18 chains 75 links, and the perpendiculars on it from two corners are 6 chains 54 links and 7 chains 82 links. Find its rent at 12*s.* a rood.

(43) Find (in acres, etc.) the area of a circular ring whose inner diameter is 6 chains 25 links, and outer diameter 10 chains 35 links.

(44) Show that the chord of a quadrant divides a circle into two parts, whose areas are as 10 to 1 very nearly.

In a circle let A B, C D, be diameters cutting each other at right angles at E. Then E is the centre of the circle. (Place the letter F on the circumference about midway between C and A.) Join C A. Then the arc C F A is a quadrant, and the straight line C A is the chord of a quadrant. The chord C A divides the circle into two segments, C F A and C B D A. Let r = radius of the circle; then diameter = $2r$.

$\therefore$ Area circle = $(2r)^2 \times \cdot7854 = 4r^2 \times \cdot7854$.

$\therefore$ Area quadrant C F A = $r^2 \times \cdot7854$.

But since C E = A E, and A E is at right angles to C E,

$\therefore$ Area triangle A C E = $\frac{1}{2}$ C E $\times$ A E = $\frac{1}{2} r^2$

And area segment C F A = area quadrant − area triangle A C E.

$= r^2 \times \cdot7854 - \frac{1}{2} r^2$

$= r^2(\cdot7854 - \cdot5) = r^2 \times \cdot2854$.

Also area segment C B D A = area circle − area segment C F A

$= 4r^2 \times \cdot7854 - r^2 \times \cdot2854$

$= r^2(3\cdot1416 - \cdot2854)$

$= r^2 \times 2\cdot8562$.

$\therefore \frac{\text{area segment C B D A}}{\text{area segment C F A}} = \frac{r^2 \times 2\cdot8562}{r^2 \times \cdot2854} = \frac{2\cdot8562}{\cdot2854} = \frac{10}{1}$ nearly.

$\therefore$ Segment C B D A : segment C F A :: 10 : 1 nearly.

Note.—Area segment C B D A might also be found thus:—

Area segment C B D A = 3 area quadrant + area triangle A C E

$= 3r^2 \times \cdot7854 + \frac{1}{2} r^2$

$= r^2(2\cdot3562 + \cdot5) = r^2 \times 2\cdot8562$.

(45) To find the area of a trapezium when a diagonal and the perpendiculars upon it from the opposite angles are given:—Multiply the sum of the perpendiculars by the diagonal, and divide by 2. Prove this rule.

(46) What rent should be paid for a triangular field whose sides are 175, 220, and 375 yards, at £6 12*s.* per acre?

(47) A rectangular park, one side of which is twice as long as the other, contains 500 acres: how much ground will be occupied by a road 15 feet wide running round it?

(48) An oblong bit of land containing 9 a. 1 r. 16$\frac{1}{2}$ p. is one-third as broad as it is long. What is the distance in poles (1)

round it, and (2) from one corner to the opposite one (three places of decimals).

(49) The area of a triangle is $30\frac{1}{16}$ square feet, and its altitude is 6 feet 4 inches; find the base.

(50) The diameter of a circle is 30 feet; find the area of a segment cut off by a chord whose length is 15 feet.

Note.—Observe, that the triangle formed by the chord and two radii is equilateral.

(51) A square deer park, including 1600 acres of land and a lake of 960 acres, is to be enclosed with a wall; what will be its length?

(52) The section of a telegraph cable is half an inch in diameter, the central wire is $\frac{1}{8}$ of an inch in diameter, and there are 4 protecting wires of $\frac{1}{16}$ inch section embedded in the hempen cable. What percentage of the cable consists of metal and what of hemp?

(53) How many flag-stones, each 5·76 feet long and 4·15 feet wide, are required to floor a cloister enclosing a rectangular court 45·77 yards long and 41·93 yards wide, the cloister itself being 12·45 feet wide?

(54) How many square inches are there in the surface of a kite whose length is 6 feet,—that being three times the radius of its semi-circular head?

(55) A square is described within the triangle formed by the diagonal and two sides of another square, having one of its angles coincident with an angle of the larger square; another square is similarly described within the smaller square, and so on; find the size of the fifth square if the largest square contains 368·64 square yards.

(56) Find the altitude of a triangle whose base is 75, and the other sides 65 and 20 yards long respectively.

(57) Each of three sides of a quadrilateral field is equal to $5\frac{1}{2}$ chains, and the fourth to 11 chains; find the area of the quadrilateral.

(58) Find the rent of a triangular field, whose base is 2220 links and perpendicular 3330 links, at thirty-five shillings per acre.

(59) The radius of a circle is 6 feet; find the area of a sector, and the length of the arc, which contains 32° 15′.

(60) Find (in acres, etc.) the area of a triangular field whose sides are 273, 425, 628 yards.

(61) The radius of a circle is 36 inches; find the length of an arc which contains 40°.

(62) The diagonal of a field is 303 yards, and it divides the field into two triangles whose sides (in yards) are 100, 217, 303, and 65, 272, 303; find the area in acres, etc.

(63) The length of a circular arc is 16½ feet, and it contains 11° 15′; find the diameter.

(64) One side of a triangle is half the sum of the two others; the sum of the three sides is 84 feet, and the area of the triangle is 14 square yards; find the sides.

(65) The radius of a circle is 37½ feet; find the area of a sector which is one-eighth of a quadrant.

(66) The length of a rectangular field is to its breadth as 6 to 5. One-sixth of the field was planted, which left 625 square yards for ploughing. What is the length?

(67) Find in yards the diameter of a circle whose area is 11 acres 3 roods $28\frac{74}{121}$ poles.

(68) The extremity of the minute hand of a clock moves 5 inches in 3½ minutes; what is its length?

(69) A ladder 38 feet long just reaches to a window 29 feet 6 inches high on one side of a street; on turning the ladder over, without moving its foot, it reaches a window 28 feet high on the other side; find the breadth of the street.

ANSWERS TO MENSURATION.

Exercise 1 (p. 445).

(4) 6347¼ sq. ft. (5) 172·5247. (6) 168 sq. ft. 135 sq. in.
(7) 36 p. 19 yds. 3 ft. (8) 152$\frac{5}{40}$. (9) 6 per. 22½ yds.
(10) 1 a. 5 sq. ch. 8875 sq. links. (11) 6 a. 2 r. 18⅜ per.
(12) 126 acres. (13) 9·6 ft. (14) 13 ft.; 546 sq. ft.
(15) 23 ft.; 27 ft.

Exercise 2 (p. 449).

(1) 1075·298375 sq. ft. (2) 695·2935168 sq. yds.
(3) 1931·37084. (4) 3077·68352.
(5) 6495·1905 ft. (6) 19·37+yds.
(7) 2·5 ft.

Exercise 3 (p. 450).

(3) 25,000·8528 miles. (4) 2·8 ft.
(5) 50. (7) 2·618 ft.
(8) 3 miles. (9) 2·94525 yds.
(10) 95·492 ft.

Exercise 4 (p. 452).

(2) 38½ sq. yds. (3) 38·4846.
(4) 132·7326 sq. yds. (5) 28·2744 sq. m.
(7) 7 inches. (8) 2·916 + ft.
(9) 1809·5616 sq. yds. (10) 39·25 yds.
(11) 1809·5616 sq. yds. (12) 539·305 + sq. ft.
(13) 5695·7208 sq. ft. (14) 140·374 sq. ft.
(16) 15·708 sq. yds. (17) 2513·28 sq. ft.

Exercise 5 (p. 455).

(3) ·35343 sq. ft. (4) 100 sq. yds.
(5) 84½ sq. in. (6) 804·39 + sq. ft.
(7) 1·76715 sq. ft. (8) 75·3984 sq. in.
(9) 112° 30′.

Exercise 6 (p. 456).

(1) 28·541. (2) 13·0584.
(3) 138·12. (4) 128·784 sq. ft. nearly.
(5) 195·152 sq. yds. (6) 57·7725 sq. inches.

Exercise 7 (p. 458).

(1) 4056 square feet.
(2) 72 sq. ft.
(3) 213.
(4) 3245704 sq. yds.
(5) 6 sec.
(6) 8·158 ft.
(7) 500 miles.
(8) 3000 sq. ft.
(9) 5 a. 2 r. 17·768 p.
(10) £78 7*s.* 0·636*d.*
(11) $26\dot{6}$ ft.
(12) 7854 : 7122.
(13) 13 ft.
(14) $681\frac{9}{11}$ links.
(15) 360.
(16) $5\frac{1}{3}$ inches.
(18) ·0424 +
(19) $4\frac{3}{8}$ ft.
(20) 864.
(21) 66990 sq. ft.
(23) 63·403 + sq. ft.
(24) 560 sq. ft.
(25) $95\frac{645}{1809}$ yds.
(26) 491·934 + sq. yds.
(28) 2 ft.
(29) £3 0*s.* 10·422*d.*
(30) $2\frac{3}{4}d.$
(31) 142·5567 + chains.
(33) £2 15*s.*
(34) 70·028 + yds.
(35) 15·197 yds.
(36) 30·5763.
(37) 4·472136 ft., or $2\sqrt{5}$ ft.
(38) Breadth, 9 in.; length, 12 in.
(39) 136·323 cwt.
(41) 1·1082 +
(42) £32 6*s.* $2\frac{3}{5}d.$
(43) 5 a. 1 r. 15·269 + p.
(46) £15 15*s.*
(47) 33100 sq. yds.
(48) $178\frac{3}{5}$ poles; 70·624 + poles.
(49) 9 ft. 8 in.
(50) 20·385 sq. ft.
(51) 8 miles.
(52) 38·0809 + p. c.; 61·919 + p. c.
(53) 300.
(54) 2056·7808 sq. in.
(55) Area 1·44 square yards.
(56) 16.
(57) 39·29475 sq. chains.
(58) £64 13*s.* $8\frac{1}{2}d.$ nearly.
(59) 10·13166 ft. nearly; 3·37723 + ft.
(60) 9 a. 2 r. $14\frac{36}{121}$ p.
(61) 2 ft. $1\frac{1}{7}$ in. nearly.
(62) 3 a. 4 p. 29 yds.
(63) 168 ft. nearly.
(64) 15, 28, 41 feet.
(65) $136\frac{8}{9}$ ft. nearly.
(66) 30 yds.
(67) 271·1 yds. nearly.
(68) 14·7 inches, nearly.
(69) 49·65 ft. nearly.

ARITHMETIC.

(MALES.)

EVOLUTION. CUBE ROOT.

To Extract the Cube Root of a Given Number.

The rule for extracting the cube root of a given number is deduced from the method employed to extract the cube root of an algebraical expression. (*See* Algebra, Cube Root.)

Rule.—Divide the number into periods of three figures each by placing a dot over the units' figure and over every third figure to the left in integers, and to the right in decimals. Each period is supposed to *end* in a figure having a dot over it. One or two ciphers may be added to the decimal figures, if required to complete a period.

Now take the first period to the left, which may consist of one, two, or three figures, according as it has a dot over the first, second, or third figure. Find the greatest cube number in that first period, place its cube root in the quotient on the right as in long division, and set the cube number itself under the first period. Subtract the cube number from the first period, and to the remainder annex the second period for the next dividend.

The figure in the quotient is the first figure of the root required. Multiply its square by 3 and set down the product to the left of the dividend just obtained, as a trial divisor. Find how many times this divisor is contained in the number obtained by omitting the two last figures to the right in the dividend; place the result in the quotient for the second figure of the cube root. Annex two ciphers to the divisor. Under the divisor thus increased set down the number obtained by multiplying the first figure of the root by 3, annexing the second figure of the root, and multiplying the result by the second figure of the root. Add together the two numbers thus placed under each

other, and the sum will be the complete divisor. Multiply the latter by the second figure of the quotient, place the product below the dividend, and subtract it therefrom. (If the product be greater than the dividend, the former must be diminished by taking a lower number as the second figure of the root.)

To the remainder bring down the figures of the third period to form a new dividend. Then multiply the square of the quotient by 3, set down the product to the left of the dividend as a trial divisor, and proceed as before.

Three times the square of the quotient may be obtained by adding together ; (*a*) the former complete divisor, (*b*) the number obtained by multiplying the first figure of the root by 3, annexing the second figure of the root, and multiplying the result by the second figure of the root, and (*c*) the square of the second figure.

Continue the process as long as any periods remain to be brought down.

If there should be a remainder after all the periods in the original number have been dealt with, the operation may be continued *decimally* by annexing three ciphers for each additional period till a sufficiently accurate result has been arrived at.

(1) Find the cube root of 76009496256.

	76009496256 (4236
	64
4800	12009
244	
5044	10088
529200	1921496
3789	
532989	1598667
53678700	322529256
76176	
53754876	322529256

Here we place a dot over the units' figure, 6, and over the third figures to the left, 6, 9, 6, thus dividing the number into the four periods 76 ; 009 ; 496 ; 256.

The first period is 76. The greatest cube number it contains is 64, which is the cube of four. We place the root, 4, in the quotient, and the cube number 64 under the first period. Subtracting, we obtain the remainder 12, to which we annex the second period, 009, thus obtaining 12009 for a dividend.

In the quotient we have 4, which is the first figure of the root. The square of 4 is 16 ; multiplying 16 by 3 we get 48, which is placed to the left of 12009 as a trial divisor. Omitting the last two figures of 12009 we have 120. In 120 the trial divisor 48 is contained twice, we therefore place 2 in the quotient as the second figure of the root. Annexing two ciphers to 48 we get 4800. Then if we multiply 4, the first figure of the root, by 3, and then annex 2, the second figure of the root, to the product, we obtain 122 ; this multiplied by 2, the second figure of the root, becomes 244. Adding 244 to 4800 we get 5044, which is the complete divisor. The product of 5044 multiplied by 2 is 10088, which, subtracted from 12009, leaves the remainder 1921.

To this remainder we bring down the next period, 496, and thus obtain the next dividend, 1921496.

The number in the quotient is now 42. The new trial divisor will be 3 times the square of 42, or 5292. This is found most readily thus : add together the last complete divisor, 5044, the number above it, 244, and the square of the second figure of the root, 2^2, or 4. Thus $5044 + 244 + 4 = 5292$. This number is contained 3 times in 19214 ; hence 3 is the third figure in the root.

We then proceed as before. Annexing two ciphers to 5292 we have 529200. Then $42 \times 3 = 126$. Annexing the third figure, 3, we have 1263 ; $1263 \times 3 = 3789$. Adding, we have the complete divisor 532989.

The next trial divisor is found in a similar manner to the preceding ones, thus : $532989 + 3789 + 3^2 = 536787$.

(2) Find the cube root of ·36 to five places of decimals.

$$\begin{array}{r|l}
 & \dot{3}60(\cdot71137+ \\
 & 343 \\
\hline
14700 & 17000 \\
211 & \\
\hline
14911 & 14911 \\
\hline
1512300 & 2089000 \\
2131 & \\
\hline
1514431 & 1514431 \\
\hline
151656300 & 574569000 \\
63999 & \\
\hline
151720299 & 455160897 \\
\hline
15178430700 & 119408103000 \\
1493779 & \\
\hline
15179924479 & 106259471353 \\
\hline
 & 13148631647 \\
\hline\hline
\end{array}$$

This example exhibits the mode of extracting the cube root of a decimal. A cipher is added to the decimal to make up the first period (reckoning from the units' place). Three ciphers are afterwards added as required for each succeeding period.

In other respects the process is precisely similar to that employed in Example I.

The cube root of a vulgar fraction is found by extracting the cube root of the numerator and that of the denominator separately.

Thus: $\sqrt[3]{\frac{1}{27}} = \frac{\sqrt[3]{1}}{\sqrt[3]{27}} = \frac{1}{3}$; $\sqrt[3]{\frac{64}{125}} = \frac{4}{5}$;

$$\sqrt[3]{2\tfrac{43}{343}} = \sqrt[3]{\tfrac{729}{343}} = \tfrac{9}{7} = 1\tfrac{2}{7}$$

Unless both numerator and denominator are exact cube numbers, it is generally better to reduce the fraction to a decimal before extracting the cube root.

Thus: $\sqrt[3]{\frac{1}{2}} = \sqrt{\cdot5} = \cdot7937+$

Exercise 1.

Extract the cube roots of :—

(1) 125 ; 27 ; 1000 ; 1331 ; 1.

(2) $\frac{1}{8}$; $\frac{8}{27}$; $\frac{343}{512}$; $3\frac{3}{8}$; $1\frac{728}{1000}$.

(3) 3375 ; 5832 ; 12167 ; 39304.

(4) 97336 ; 250047 ; 132651 ; 912673.

(5) 771095213 ; 49754821752 ; 19968681097.

(6) 57915683909 ; 219365327791.

(7) 197137·368 ; 941192.

(8) Find the cube root of 8·1 to two places of decimals.

(9) Find the cube roots of the following numbers to five places of decimals : 51 ; 3 ; 31 ; 50.

(10) What is the smallest alteration of the number 831600, which, either by addition or subtraction, will make it into a perfect cube?

Exercise 2.

(*Miscellaneous Examples.*)

(*Note.*—The following examples are all taken from Government Examination Papers.)

(1) A half-sovereign of standard gold weighs 2·568 dwts. ; a sixpenny piece of standard silver weighs $\frac{1}{152}$ lbs. ; compare together the weights of 10,000 of each coin, and both with 100 lbs.

(2) An engine of 8-horse power can pump out $\frac{3}{7}$ of the contents of a tank $18\frac{1}{2}$ feet deep in 3 days, working 7 hours a day ; in how many days will an engine of 15-horse power, working 8 hours a day, empty the tank?

(3) A ship and its cargo are worth £17,600, and the cargo is worth seven times as much as the ship ; find the values of the ship and cargo respectively.

(4) Two couriers start at the same time from two places 280 miles apart ; when will they meet on the road, if they travel towards each other, one at the rate of 9 miles an hour, and the other at the rate of 11?

(5) Three candidates stand for a borough of 12,000 inhabi-

tants, of whom $\frac{3}{15}$ possess the elective franchise. A polls 3 per cent. of the whole population, B polls 15 per cent. of the electors, and C polls 20 per cent. of those who actually voted. Give the number polled by each candidate.

(6) A guinea is divided between A, B, and C. A's share is $\frac{3}{5}$ of B's, but it is also $\frac{3}{5}$ of B's and C's together; how was the guinea divided?

Let 1 represent B's share.

Then $\frac{3}{5}$ will represent A's share.

Also $\frac{3}{5}$ will represent $\frac{3}{5}$ of B's share + $\frac{3}{5}$ of C's share.

But $\frac{3}{5}$ of B's share is represented by $\frac{3}{5}$

$\therefore$ $\frac{3}{5}$ of C's share will be represented by $\frac{3}{5} - \frac{3}{5} = \frac{1}{5}$

$\therefore$ $\frac{1}{5}$ of C's share will be represented by $\frac{1}{10}$

$\therefore$ the whole of C's share will be represented by $\frac{5}{10} = \frac{1}{2}$.

A's share : B's share : C's share :: $\frac{3}{5}$: 1 : $\frac{1}{2}$.

Or :: $\frac{6}{10}$: $\frac{10}{10}$: $\frac{5}{10}$.

Or :: 6 : 10 : 5.

And 6 + 10 + 5 = 21.

$\therefore$ A's share = $\frac{6}{21}$ of 1 guinea = 6*s*.

B's share = $\frac{10}{21}$ of „ = 10*s*.

C's share = $\frac{5}{21}$ of „ = 5*s*.

(7) A farmer had 50 couple of poultry; turkeys, ducks, and chickens. The turkeys were worth 15*s*. each; ducks, 5*s*.; chickens, 2*s*. 6*d*.; but he had the same value *in money* of each kind. How many birds of each description did he keep, and what was the value of his whole stock?

(8) A general contracted to pay £5,454 for 13,635 pairs of boots and shoes for his army. The price of each pair of shoes was to that of each pair of boots as 5 to 8, but the number of the pairs of shoes was to the number of the pairs of boots as 2 to 1. Give the numbers and prices respectively of the pairs of the boots and shoes.

(9) A man buys a farm of 150 acres for £4,624, and, after repairing the buildings, lets it at 30 shillings an acre, thereby getting a return of 4½ per cent. for his money. What sum did he spend in repairs?

(10) A boat's crew rowed up from London to Kingston and back in 11 hours allowing one hour for rest. They found they could make 5 miles *with* the stream for $3.\dot{3}$ *against* it. What time did they take to go, and what time to return?

(11) Divide 12012 in the proportion of 2, $5\frac{1}{3}$, $5\frac{1}{2}$.

(12) If I sell out my property in the 3 per cents standing at $96\frac{1}{8}$, and invest the proceeds in £100 railway stock, standing at $55\frac{7}{8}$, and paying a dividend of $1\frac{3}{4}$ per cent., if $\frac{1}{8}$ be allowed for brokerage in each case, will this transaction increase or diminish my income?

(13) If the letter *e* occurs on an average 5 times in eight words, what number of *e's* would be wanted to print a volume containing 240 pages, each page averaging 27 lines, each line 11 words, and each word $3\frac{3}{4}$ letters? And what is the percentage of *e's* as compared with the whole of the letters used?

(14) If ·004 be the proper percentage of carbonic acid gas in the air, how many cubic feet of that gas should there be in a church 160 feet long, 50 wide, and 75 high; and what would that quantity be, stated in cubic yards?

(15) What is the prime cost of a yard of cloth, if selling it at 7 per cent. advance brings 5*s.* more than selling it at 17 per cent. loss?

(16) If the dollar be current for 4*s.* 2*d.*, the franc for $9\frac{3}{4}d.$, and the rupee for 1*s.* $10\frac{1}{4}d.$, what is the *average* income of five persons, one of whom receives 5000 dollars, two receive 20,000 francs each, and two receive 10,000 rupees each?

(17) Cannon balls are piled in a regular square based pyramid, one ball at the top and 121 in the layer lying on the ground. What is the average number of balls in a layer?

(18) If the price of one ton be :—
$(\sqrt{\cdot 81} + \sqrt{\cdot 01} + \sqrt{72\cdot 25} + \sqrt[3]{\cdot 125})$£, what is the value of 1 cwt.?

(19) A man inheriting money spends on the first day 19*s.*, twice that sum the next day, and 19*s.* additional every day till he exhausts his fortune by spending on the last day £190. What had he to start with?

(20) John had 3*s.* and gave away 1½*d.*; William had 4*s.* 8*d.* and gave away 3½*d.* How much more per cent. of his money did the latter give than the former?

(21) If gunpowder contains 76 per cent. of nitre, 9·5 per cent. of sulphur, and 14·5 per cent. of charcoal, what weights of nitre, sulphur, and charcoal, severally, will there be in 2 tons of gunpowder?

(22) 21,500 effective men remain out of an army of which ·16 died in battle, ·1 had been taken prisoners, and ·1361 were in hospital. What was the original strength of the army?

(23) Divide 85 into two parts, so that $\frac{2}{3}$ of the one may be $\frac{4}{5}$ of the other.

(24) Show that the difference between the interest and the discount on the same sum for the same time is the interest of the discount.

Let the rate per cent. be 5, and time 1 year.

Then, Discount on £105 = £5
= Interest on £100.

Interest on £105 = Interest on £100 + Interest on £5.

∴ Interest on £105 — Discount on £105
= Interest on £100 + Interest on £5 — Interest on £100
= Interest on £5
= Interest on discount on £105.

The same result would be arrived at for any sum, at any rate per cent., and for any time.

(25) 1200 men can complete a work in 12 weeks. At the end of two weeks 300 men are added, and two weeks after that 500 men are withdrawn. How much longer should the work last (after the 500 men are withdrawn)?

(26) One fourth of an estate belongs to A, $\frac{2}{5}$ of it to B, and the remainder to C, which is worth £2,500 more than A's share. What is the value of the whole?

(27) Bought 18 cwt. 3 qrs. 24 lbs. of saltpetre at £1 6*s.* 10*d.* per cwt.; sold half of it at 3*d.* per lb., and the other half at £1 3*s.* 4*d.* per cwt. What did I gain or lose on the whole, and how much per cent.?

(28) Find the interest on £34,675 for 17 days at 5 per cent. and distribute that interest among 3 persons, A, B, and C, in the ratio of 1, $1\frac{1}{2}$, and $2\frac{1}{2}$.

(29) A steamer is $14\frac{3}{4}$ days on a voyage. For the first three days she makes 13 miles an hour. In the next six and a half days she improves upon that speed 17 per cent.; and for the remaining time she runs 390 miles in the 24 hours. What distance has she gone, and what was her average speed per hour?

(30) How much higher will the terminus of a railroad 280 miles long be than its starting-point, if for ·25 of its length the line ascends 1 foot in 90, and for the last ·1 of its length descends 1 foot in 55, the remainder being level?

(31) A and B together do a piece of work in eleven days; A and C together do the same piece of work in five days; and B and C together do it in eight days. How long would it take each working alone?

A and B together do $\frac{1}{11}$ of the work in 1 day.
A and C „ $\frac{1}{5}$ „ in 1 day.
B and C „ $\frac{1}{8}$ „ in 1 day.

Therefore, adding

2 A + 2 B + 2 C do $\frac{1}{11} + \frac{1}{5} + \frac{1}{8}$ of the work in one day,

$$\frac{1}{11} + \frac{1}{5} + \frac{1}{8} = \frac{183}{440}$$

$\therefore$ A, B, and C together do $\frac{1}{2}$ of $\frac{183}{440} = \frac{183}{880}$ of the work in 1 day.

But B and C together do $\frac{1}{8}$ of the work in one day.

Therefore, subtracting,

A does $\frac{183}{880} - \frac{1}{8} = \frac{73}{880}$ of the work in one day.
Similarly B does $\frac{183}{880} - \frac{1}{5} = \frac{7}{880}$ of the work in one day.
And C does $\frac{183}{880} - \frac{1}{11} = \frac{103}{880}$ of the work in one day.

$\therefore$ Number of days required by A $= 1 \div \frac{73}{880} = \frac{880}{73}$
$= 12\frac{4}{73}$ days.

Number of days required by B $= 1 \div \frac{7}{880} = \frac{880}{7}$
$= 125\frac{5}{7}$ days.

Number of days required by C $= 1 \div \frac{103}{880} = \frac{880}{103}$
$= 8\frac{56}{103}$ days.

(32) What amount of money is the same fraction of a crown that 2*s.* $9\frac{3}{5}$*d.* is of a guinea?

(33) The contents of a cistern is the sum of two cubes, whose edges are 12 inches and 10 inches respectively, and the area of whose base is the difference of two squares, whose sides are $1\frac{1}{3}$ feet and $1\frac{2}{3}$ feet respectively. Find its depth.

(34) Extract the cube root of 357,911; *or* of 91·125; *or* of $37\frac{1}{27}$.

(35) A grocer buys sugar at 7*d.* and at 10*d.* per lb.; and mixes them in the proportion of 3 : 5; what will he gain or lose per cent. if he sells the mixture at 9*d.* per lb.?

(36) Standard gold being coined at the rate of £3 17*s.* $10\frac{1}{2}$*d.* per ounce, what is the least number of ounces that can be coined into an exact number of sovereigns?

Since £3 17*s.* $10\frac{1}{2}$*d.* $= £3\frac{42}{48}0 = £3\frac{21}{160}$, it is required to multiply $3\frac{21}{160}$ by such a number as will make the product an integer.

Since the fraction is in its lowest terms, it is evident that the least number which will do this is the denominator, 160.

Therefore, the least number of ounces is 160.

(37) If a four-oared boat cost £50, what would a six-oared boat cost, on the supposition that the expense of setting up a boat is proportionate to the square of the number of oars? Which would cost least per head?

(38) If A's rate of profit is $\frac{4}{5}$ of B's, and, for every guinea that B gains, C gains a sovereign; compare the profits of A and C.

(39) If, when 25 per cent. is lost in grinding wheat, a country has to import ten million quarters, but can maintain itself on its own produce if only 5 per cent. be lost, find the quantity of wheat grown in the country.

(40) A young clerk is offered a salary of £50 a year, with his choice of an increase of £2 per quarter, or of £35 per year. Compare the sums total of his earnings at the end of 5 years, according as he adopts one or the other alternative.

(41) Divide 100 guineas into an equal number of guineas,

half-guineas, crowns, half-crowns, shillings, and sixpences, and reduce the remainder to the fraction of £1.

(42) In a gale, a flagstaff 20 yards high, standing on level ground, snaps 28·8 feet from the bottom, and the upper portion not being wholly broken off, the top touches the ground. How far is its point of contact with the ground from the bottom of the staff?

(43) What is meant by the "reciprocal" of a number? What fraction divided by its reciprocal gives a quotient $= \frac{5}{2}\frac{5}{7}\frac{3}{3}$?

The reciprocal of a number is the quotient of *unity* (1) divided by the number.

Thus, the reciprocal of 1 is $\frac{1}{1} = 1$
the reciprocal of 2 is $\frac{1}{2}$
the reciprocal of 5 is $\frac{1}{5}$
the reciprocal of $\frac{3}{7}$ is $1 \div \frac{3}{7} = \frac{7}{3}$

The last example shows that the reciprocal of a *fraction* is simply the fraction *inverted.*

Any number divided by its reciprocal gives the square of that number.

Thus, $2 \div \frac{1}{2} = 2^2$
$5 \div \frac{1}{5} = 5^2$
$\frac{3}{7} \div \frac{7}{3} = \frac{3^2}{7^2}$

Hence, to find a number which, divided by its reciprocal, gives a certain quotient, it is only necessary to take the *square* root of that quotient.

Thus, the number which, divided by its reciprocal, gives a quotient 25 $(= 5^2)$ is 5.

Therefore, the fraction required $= \sqrt{\frac{5}{2}\frac{5}{7}\frac{3}{3}}$
$= \sqrt{\frac{9}{16}} = \frac{3}{4}$

(44) Find the *average* of the following quantities, and state it as a decimal:—

$\sqrt{2\frac{7}{9}}$, $[(\frac{1}{9}$ of $3\frac{3}{8}) + (\frac{2}{3}$ of $\frac{1}{6})]^2$, $\sqrt[3]{\cdot 343}$, 1·001, and 1.

(45) A grocer buys 367 cwt. of sugar at £1 19*s.* 10½*d.* per cwt., and mixes it with 1161 cwt. at £2 2*s.* 6½*d.* per cwt.; at

what price per *lb.* should he sell the mixture to gain a profit at 12 per cent. ?

(46) What is the least number of years for which simple interest must be reckoned at 4 per cent. on £145 7*s.* 6*d.*, so that the interest may be an exact number of pounds sterling ?

(47) A box with square ends $1\frac{3}{8}$ ft. wide takes $84\frac{29}{33}$ ft. of board 12 inches wide to make it. What is the length of the lid ?

(48) An acre is sometimes roughly said to be 70 yards square. What would the error amount to, if we adopted this statement, in calculating the area of Ireland (32,450 square miles) ? Give answer in decimals of square miles.

(49) A and B received for digging a garden 5*s.* They worked together at it for $4\frac{1}{2}$ hours ; B then left, and A finished it in 3 hours more. If the payment is divided fairly, what (*a*) percentage and (*b*) decimal will the lesser share be of the greater ?

(50) A man bought a field, and gave a bill of £482, due in two months, for it, and sold it at once for a bill of £509 5*s.*, due in 5 months ; required his gain per cent., reckoning interest at $2\frac{1}{2}$ per cent. per annum on the bills.

(51) What is the smallest alteration of the number 710,650, which, either by addition or subtraction, will make it into a perfect cube.

(52) A body appears to weigh $5\frac{1}{16}$lbs. in one scale of a false balance, and $5\frac{4}{9}$lbs. in the other scale ; what is its true weight, and what could a fraudulent tradesman, who used such a balance, gain per cent. in selling his goods ?

The mode of working this example is based on the principle of the lever. (*See* works on Mechanics.)

The True Weight may be found thus :—***Multiply the apparent weight in one scale by the apparent weight in the other scale; the square root of the product will be True Weight.***

Thus, True Weight $= \sqrt{5\frac{1}{16} \times 5\frac{4}{9}} = \sqrt{\frac{81}{16}} = \frac{9}{4} = 5\frac{1}{4}$ lb.

Thus, an article weighing only $5\frac{1}{4}$ lbs. *appears* to weigh $5\frac{4}{9}$ lbs. the false balance.

Hence the tradesman's gain on $5\frac{1}{2}$lbs. is $5\frac{1}{2} - 5\frac{1}{4} = \frac{7}{80}$ lb.

∴ His gain on 100 lbs. may be found by the following proportion :—

$5\frac{1}{4}$ lbs. : 100 lbs. :: $\frac{7}{80}$ lbs. : gain on 100 lbs.

By working out in the usual manner we find that

Gain on 100 lbs. $= 3\dot{7}0\dot{3}$ lbs.

∴ Gain per cent. $= 3\dot{7}0\dot{3}$

(53) Show that the cube root of every perfect cube less than a million can be determined by inspection.

The cube root of 1,000,000 is 100, and the cube root of 1 is 1; therefore the cube root of any perfect cube between 1,000,000 and 1 must consist of either one or two figures, and not more.

Take any perfect cube, as 132651. Let it be pointed as in the rule for cube root, thus; 132651.

Then the first figure of the root can be found at once, since it is the root of the largest cube number contained in the first period, 132. The largest cube number in 132 is 125, which is the cube of 5. Therefore the first figure of the root is 5.

The second figure of the root is found thus: the units' figure in the perfect cube is 1, hence the second or units' figure of the root must be such a figure as when cubed will also have 1 for its units' figure. Now 1 is the only digit which has 1 for the units' figure of its cube. Therefore the second figure of the root is 1.

Hence the cube root is 51.

ANSWERS TO ARITHMETIC.

(MALES.)

Exercise 1 (p. 477).

(1) 5, 3, 10, 11, 1.
(2) $\frac{1}{2}$, $\frac{2}{3}$, $\frac{7}{10}$, $1\frac{1}{2}$, $1\frac{1}{3}$.
(3) 15, 18, 23, 34.
(4) 46, 63, 51, 97.
(5) 917, 3678, 2713.
(6) 3864, 6031.

(7) 58·2, 98. (8) 2·008.
(9) 3·70842, 1·44226, 3·14138, 3·68403.
(10) 1016 subtracted.

Exercise 2 (p. 477).

(1) 107 : $75\frac{8}{33}$; $182\frac{1}{33}$: 100. (2) $4\frac{9}{10}$ days.
(3) Ship, £2200 ; cargo, £15400. (4) 14 hrs.
(5) A, 360 ; B, 240 ; C, 150. (6) 6*s.* ; 10*s.* ; 5*s.*
(7) 60 chickens, 30 ducks, 10 turkeys ; value £22 10*s.*
(8) 4545 pairs of boots ; 9090 pairs of shoes. Boots, 10*s.* 8*d.* ; shoes, 6*s.* 8*d.*
(9) £376. (10) 6 hrs. ; 4 hrs.
(11) 1872, 4992, 5148. (12) Income as before.
(13) 44550 ; $16\frac{2}{3}$ per cent. (14) 24 cub. ft. = $\frac{8}{9}$ cub. yds.
(15) £1 0*s.* 10*d.* (16) £904 3*s.* 4*d.*
(17) 46. (18) 10*s.*
(19) £19,095. (20) $2\frac{1}{13}$ per cent.
(21) Nitre, 1·52 ton ; sulphur, ·19 ton ; charcoal, ·29 ton.
(22) 36,000. (23) 40 ; 45.
(25) 9 weeks. (26) £9000.
(27) Loss, £1 2*s.* $1\frac{1}{2}$*d.* ; $4\frac{9}{23}$ per cent.
(28) £80 15*s.* ; A, £16 3*s.* ; B, £24 4*s.* 6*d.* ; C, £40 7*s.* 6*d.*
(29) 5356·26 miles ; 15·13 + miles.
(30) $1418\frac{2}{3}$ ft.
(31) A, $12\frac{4}{7}$ days ; B, $125\frac{5}{7}$ days ; C, $8\frac{56}{105}$ days. (32) 8*d.*
(33) $73\frac{1}{14}$ inches. (34) 71 ; 4·5 ; $3\frac{1}{2}$.
(35) $1\frac{29}{77}$ per cent. (36) 160 ozs.
(37) £112 10*s.* ; four-oared. (38) 7 : 15
(39) 50,000,000 qrs. (40) £630 ; £600.
(41) 51 ; £$1\frac{29}{40}$. (42) 12 ft.
(43) $\frac{3}{4}$. (44) ·92353.
(45) $5\frac{43}{168}$*d.* (46) 200.
(47) $14\frac{2}{7}$ft. (48) 402·27 sq. m.
(49) 60 per cent. ; ·6. (50) 5 per cent.
(51) 1 subtracted. (52) $5\frac{1}{4}$lb. ; 3·703 per cent.

(FEMALES.)

INTEREST.

Interest is the consideration paid for the use of money lent.

The **Rate** of interest is the consideration paid for the use of a certain sum for a certain time.

Interest is usually calculated on the basis of so much per £100 for each year the money is lent; or at the *rate* of so much *per cent. per annum.*

Thus, if a person borrows money at the rate of £5 for each £100 for each year the loan continues, the interest is said to be at the rate of 5 per cent. per annum. So, "per cent." means, for each £100; "per annum" means, for each year.

The money lent is called the **Principal.**

The Principal, together with the interest at the end of any given period, is called the **Amount.** Thus, if £100 be lent for a year at 5 per cent., the interest at the end of the year would be £5, and the Amount at the end of that time would be £100 + £5 = £105.

Interest may be either Simple or Compound.

Simple Interest is that which is received only on the original Principal.

Compound Interest is that which is received, not only on the original principal, but on the interest which accrues from time to time, and which, being added to the sum originally lent, becomes new Principal. Thus, if £100 be lent for 5 years at Compound Interest, at the end of the first year the interest, £5, is not paid to the lender, but remains in the hands of the borrower, who therefore has to pay interest during the second year on £105. Similarly, during the third year he has to pay interest on £105 + interest on £105 for one year, and so on till the end of the five years.

Thus, in Simple Interest the Principal always remains the same, but in Compound Interest the Principal is increased at the end of any given period by the Interest due for that given period.

SIMPLE INTEREST.

To find the Interest of a given sum of money at a given rate per cent., for a given number of years.

Rule.—Multiply the Principal by the rate per cent., divide the product by 100, and multiply the result by the number of years.

(1) Find the Interest on £300 for 3 years at 4 per cent.

Here, Interest on £100 for 1 year at 1 per cent. $= £1 = \frac{£100}{100}$

$\therefore$ " £300 " at 1 per cent. $= \frac{£300}{100}$

$\therefore$ " £300 " at 4 per cent. $= \frac{£300 \times 4}{100}$

$\therefore$ " £300 for 3 years at 4 per cent. $= \frac{£300 \times 4 \times 3}{100}$

$= £36$

The reason of the rule will appear from the above example.

(2) Find the Interest on £925 16*s.* 8*d.* at 7 per cent. for 5½ years.

£	*s.*	*d.*
925	16	8
		7
64,80	16	8
20		
16,16		
12		
2,00		

£	*s.*	*d.*	
2) 64	16	2	
		5½	
324	0	10	
32	8	1	
356	8	11	Answer.

Here the Principal is £925 16*s.* 8*d.* Following the rule, we multiply this by the rate per cent. (7) and divide by 100 (cutting off two figures to the right in each line). We thus get the Interest for *one* year, viz., £64 16*s.* 2*d.*; then, multiplying by 5½, we obtain the Interest for 5½ years.

Note.—It is sometimes convenient to multiply by both the rate per cent. and the number of years before dividing by 100.

If the *Amount* were required in Example 2, it would be found by adding the Principal to the Interest, thus :—

£925 16*s.* 8*d.* + £356 8*s.* 11*d.* = £1282 5*s.* 7*d.*

(3) Find the Interest and Amount of £1284 15*s.* 10*d.* at $2\frac{1}{2}$ per cent. for 3 yr. 5 m.

£	*s.*	*d.*		£	*s.*	*d.*	
1284	15	10		32	2	$4\frac{3}{4}$	
		$2\frac{1}{2}$				$3\frac{5}{12}$	
2569	11	8		96	7	$2\frac{1}{4}$	
642	7	11		13	7	$7\frac{47}{48}$	
32,11	19	7		109	14	$10\frac{11}{48}$	Interest
20				1284	15	10	
2,39				1394	10	$8\frac{11}{48}$	Amount
12							
4,75							
4							
3,00							

Here 3 yr. 5 m. = $3\frac{5}{12}$ years.

(4) What will £1126 amount to in 4 years 17 weeks, at 5 per cent. ?

£	£	*s.*	
1126	56	6	Int. 1 year.
5	4		
56,30	225	4	Int. 4 years.
20			
6,00			

Interest for 1 year = £56 6*s.*

Therefore, by Rule of Three,—

Weeks. Weeks.

52 : 17 :: £56 6*s.* : £18 8*s.* $1\frac{5}{13}$*d.*

	£	s.	d.
∴ Interest for 17 weeks	= 18	8	$1\frac{5}{13}$
And Interest for 4 years	= 225	4	0
∴ Interest for 4 yrs. 17 wks	= 243	12	$1\frac{5}{13}$
	1126	0	0
∴ Amount	= 1369	12	$1\frac{5}{13}$

(5) Find the Interest of £173 15*s.* from March 5 to October 10, at 5 per cent.

£ s.
173 15
5
8,68 15
20
13,75
12
9,00

Interest for 1 year = £8 13*s.* 9*d.*

Now, from March 5 to October 10 (not reckoning the *first* day), we have 219 days.

And Interest for 365 days (1 yr.) = £8 13*s.* 9*d.*

Therefore, by Rule of Three,—

Days. Days.
365 : 219 :: £8 13*s.* 9*d.* : £5 4*s.* 3*d.*

∴ Interest from Mar. 5 to Oct. 10 = £5 4*s.* 3*d.*

Exercise 1.

(1) Find the simple interest on £945 10*s.* for 4 years at 5 per cent.

(2) Find the amount of £575 at 3½ per cent. for 6 years.

(3) Find the interest on £1061 15*s.* at 2½ per cent. for ½ years.

(4) Find the interest on £117 17*s.* 2*d.* at 10 per cent. for 6 years.

(*Note.*—The following examples are all taken from Government Examination Papers.)

(5) Required the amount of £537 16*s.* 8*d.* in 4 years at 2½ per cent., simple interest.

(6) Find the simple interest and amount of £7506 for 7½ years at 4¾ per cent. per annum.

(7) Find the amount of £325 16*s.* 8*d.* at 4½ per cent., simple interest, in 3½ years.

(8) What would £120 10*s.* amount to in 2½ years at 4¾ per cent.?

(9) What is the simple interest on £185 for 4 years at 4 per cent. per annum?

(10) Find the amount of £220 for 7 months at 3¾ per cent. per annum.

(11) Find the simple interest on £888 for 4½ years at 3¼ per cent.

(12) Find the simple interest on £2500 for 11¼ years at 5½ per cent. per annum.

(13) Find the simple interest on £90,010 for 7 years and 6 months at 3¼ per cent. per annum.

(14) Find the simple interest on £926 15*s.* for 200 days at 7 per cent. per annum.

(15) Find the interest on £245 16*s.* for 73 days at 2½ per cent. per annum.

(16) Find the simple interest and amount of £417 7*s.* 9*d.* for 1 year 10 months at 4⅜ per cent.

(17) What is the interest of £535 for 117 days at 4¾ per cent.?

(18) Find the interest on £800 15*s.* for 3 years 71 days, at 5 per cent.

(19) Find the interest on £716 17*s.* 9*d.* for 1 year 79 days at 3¾ per cent.

(20) What is the difference between the simple interest of £50 19*s.* for 7 years at 3 per cent., and that of the same sum for 8 years at 2½ per cent.?

(21) £550 10*s.* was borrowed January 1st, 1861, at the rate of £5 per cent. per annum, what sum repaid the debt on the 20th of October in the same year?

(22) Find the simple interest on £639 8*s.* from May 10th to August 20th, at 5½ per cent. per annum.

(23) Find the interest on £2755 15*s.* for 3 years 110 days at £3 2*s.* 6*d.* per cent.

(24) Find the simple interest on £10,400 at 4 per cent. per annum for 4 years 16 weeks, reckoning 52 weeks to a year.

(25) Find the simple interest on £880 for 5¾ months at 7½ per cent. per annum.

(26) Find the simple interest and amount of £1277 10*s.*, from the 31st of March till the 4th of July of the same year, at 8 per cent. per annum.

(27) Find the interest on £286 from the 1st of June to the 15th of September, at 3½ per cent. per annum.

(28) What is the interest of £100, for 27 weeks 3 days at 5 per cent.?

(29) What is the amount of £297 15*s.* 6*d.* for 12 weeks 4 days at 3½ per cent.?

(30) If I am entitled to $\frac{9}{10}$ of the interest on £750 from March 3 to July 27 at 5½ per cent. per annum, how much should I receive?

In questions of Interest, four things have to be considered, **Principal, Rate per cent., Time, Interest.** (The **Amount** is simply the Principal and Interest added together.)

If any three of these be given, it is possible to find the fourth.

Thus, we have already shown how the *Interest* (or Amount) may be found when the Principal, Rate, and Time are given.

We now proceed to give examples showing how the Principal, Rate, or Time may be found.

(1) What amount of capital would be required in order to gain £12 1*s.* 0¾*d.* in 2 years 5 months, at 3½ per cent.?

Here it is required to find the Principal; Interest, Rate, and Time being given.

Now, £100 would gain in 1 year £3 10*s.*
∴ £100 „ „ 2 years £7.
And £100 „ „ 2 years 5 months £8 9*s.* 2*d.*

The question now stands thus:—If £100 gain £8 9*s.* 2*d.*, how much would gain £12 1*s.* $0\frac{3}{4}$*d.* in the same time? Therefore, by Rule of Three—

£	*s.*	*d.*		£	*s.*	*d.*		£		£	*s.*
8	9	2	:	12	1	$0\frac{3}{4}$	::	100	:	142	10

The capital required is therefore £142 10*s.*

(2) What sum of money will amount to £256 10*s.* in 4 years, at $3\frac{1}{2}$ per cent. simple interest?

Here it is required to find the Principal; Amount, Rate, and Time being given.

Now, £100 would gain in 1 year £3 10*s.*
∴ £100 „ „ 4 years £14.
∴ £100 in 4 years will amount to £114.

The question now stands thus:—If £100 amounts to £114, how much will amount to £256 10*s.* in the same time? Therefore, by Rule of Three—

£		£	*s.*		£		£
114	:	256	10	::	100	:	225.

The sum of money, or *Principal*, is therefore £225.

(3) At what rate per cent. (simple interest) will £250 amount to £300 12*s.* 6*d.* in $4\frac{1}{2}$ years?

Here Amount = £300 12*s.* 6*d.*
Principal = £250
∴ Interest = £50 12*s.* 6*d.*

Now, at 1 per cent. £100 in 1 year gains £1
∴ „ £250 „ „ £2 10*s.*
∴ „ £250 in $4\frac{1}{2}$ years „ £11 5*s.*

The question now stands thus:—If at one per cent. a sum of money gains £11 5*s.*, at what rate per cent. will it gain £50 12*s.* 6*d.*?

Therefore, by Rule of Three,—

£	s.		£	s.	d.				
11	5	:	50	12	6	::	1	:	$4\frac{1}{2}$

The *Rate per cent.* is therefore $4\frac{1}{2}$.

(4) Find the time in which the (*simple*) interest on £750 10*s.* will amount to £712 19*s.* 6*d.*, at $4\frac{3}{4}$ per cent.

In 1 year interest on £750 10*s.* at $4\frac{3}{4}$ per cent.=£35 12*s.* $11\frac{7}{10}$*d.*

The question now stands thus:—If in 1 year the interest on £750 10*s.* amounts to £35 12*s.* $11\frac{7}{10}$*d.*, in what time will it amount to £712 19*s.* 6*d.*?

Therefore, by Rule of Three,—

£	s.	d.		£	s.	d.		yr.		yrs.
35	12	$11\frac{7}{10}$	:	712	19	6	::	1	:	20

The *Time* is therefore 20 years.

Exercise 2.

(*Note.*—The following examples are all taken from Government Examination Papers.)

(1) At what rate per cent. (simple interest) will £250 amount to £300 12*s.* 6*d.* in $4\frac{1}{2}$ years?

(2) What sum must be laid out at $3\frac{1}{2}$ per cent. simple interest to amount to £980 10*s.* 6*d.* in $4\frac{1}{2}$ years?

(3) At what rate per cent. (simple interest) will £1016 amount to £1250 in 5 years 5 months?

(4) If £880 amount to £899 5*s.* at simple interest for $\frac{7}{15}$ of a year, what must be the rate per cent. per annum?

(5) In what time will £225 amount to £256 10*s.* at $3\frac{1}{2}$ per cent. per annum, simple interest?

(6) At what rate per cent. simple interest will £936 13*s.* 4*d.* amount to £1157 7*s.* $4\frac{1}{2}$*d.* in $4\frac{7}{8}$ years?

(7) In what time will £225 amount to £256 10*s.* at $1\frac{3}{4}$ per cent. per annum?

(8) What sum will amount to £105 6*s.* $0\frac{1}{2}$*d.* in $3\frac{1}{2}$ years at $4\frac{1}{4}$ per cent. per annum simple interest?

(9) In what time will £91 13*s.* 4*d.* amount to £105 6*s.* $0\frac{1}{2}$*d.* at $4\frac{1}{4}$ per cent per annum?

(10) A sum invested at $8\frac{1}{8}$ per cent. per annum amounts to 5 guineas in 219 days; what is the sum?

(11) Find the rate per cent. at which £411 10*s.* will amount to £416 10*s.* 3*d.* in a quarter of a year?

(12) What sum will amount to £387 7*s.* $7\frac{1}{2}$*d.* in 3 years at 4 per cent. per annum, simple interest?

(13) What principal will yield £43 10*s.* $7\frac{1}{2}$*d.* simple interest in 3 years at 4 per cent. per annum?

(14) In what time will any sum of money treble itself at $2\frac{1}{2}$ per cent. and at $12\frac{1}{2}$ per cent. per annum, simple interest?

This is equivalent to asking,—In what time will £100 amount to £300; or, in what time will the *interest* on £100 amount to £200 at $2\frac{1}{2}$ per cent. and at $12\frac{1}{2}$ per cent.? The question thus resolves itself into a problem in which it is required to find the *time;* the principal, rate per cent., and interest being given.

(15) I invested £730 on the 25th of March, and on the 29th of September following it amounted to £777. What was the rate of interest per cent. per annum?

(16) In what time will £229 10*s.* amount to £258 3*s.* 9*d.* at 5 per cent. per annum, simple interest?

(17) What sum of money put out at 10 per cent. will produce £12 10*s.* for interest in 10 days?

(18) What principal, lent at simple interest on the 1st of January, at $5\frac{1}{2}$ per cent., would amount to £1000 on the 29th of September of the same year?

(19) The interest on £754 6*s.* 8*d.* for 8 months 10 days is £23 5*s.*; what is the rate per cent. per annum?

(20) The interest on a certain sum lent for 85 days at £4 6*s.* 8*d.* per cent. per annum is £3 13*s.* 8*d.*; what was the principal?

(21) What sum of money put out to interest will amount to £194 16*s.* 1·2*d.* in $2\frac{3}{4}$ years, at 4 per cent. per annum (simple interest)?

(22) What sum of money at simple interest for 3 years at 4·6 per cent. per annum will amount to £615·6?

(23) What sum, invested at 5 per cent. per annum, simple

interest, will produce in 4 years the same amount of interest as £250 lent out at 3 per cent. would produce in 6 years?

(24) A sum of money has doubled itself in 16 years at simple interest; what is the rate per cent.?

(25) On the 1st of January, 1870, a contractor borrows a sum of money at 5 per cent. simple interest. At the end of a year the rate of interest is reduced to 4½ per cent. The total amount of interest up to the end of 1875 is £1760. What was the sum borrowed?

COMPOUND INTEREST.

In Compound Interest, at the end of each year (or other given period) the interest is added to the principal, as already explained.

The difference between Simple and Compound Interest may be illustrated thus:—A person deposits his money in a savings'-bank; if he withdraw the interest added to his deposits at the end of each year, the interest he receives will be simple; but if he allow it to remain and accumulate as principal from year to year, the interest he receives will then be compound.

To find the Compound Interest on a given sum of money at a given rate per cent. for a given time.

Rule.—Find the interest to the end of each year (or other given period) as explained under Simple Interest, add the interest to the first principal to find the principal for the second year (or other given period). Then find the interest for the second year (or other given period) on the second principal so obtained. Then add the interest of the second year (or other given period) to the second principal. Continue this process to the end of the given time. The result obtained will be the *Amount* at compound interest. The *Compound Interest* will then be found by subtracting the original principal from the amount.

(1) Find the compound interest on £457 10*s.* at 4 per cent. per annum for 3 years.

	£	s.	d.
First Principal . . .	457	10	0
First Year's Interest . .	18	6	0
Second Principal . . .	475	16	0
Second Year's Interest . .	19	0	7·68
Third Principal . . .	494	16	7·68
Third Year's Interest . .	19	15	10·3872
Amount at end of Third Year	514	12	6·0672
Subtract First Principal . .	457	10	0
Compound Interest . .	57	2	6·0672

Here we suppose that the interest is to be added at the end of each year, since no other period is stated.

The mode of working sums of this kind will be clear from the above example. We have not considered it necessary to set down the working of the interest for each year, as that has already been fully explained under Simple Interest. The pupil should, however, of course, exhibit the whole of the operations on his Examination Paper.

It is generally better to employ decimal than vulgar fractions in working examples in Compound Interest.

(2) If the sum of £1200 be put out at 10 per cent. per annum, compound interest, paid half yearly, what will it amount to in $1\frac{1}{2}$ years.

	£	s.	d.
First Principal . . .	1200	0	0
First $\frac{1}{2}$ year's Interest .	60	0	0
Second Principal . .	1260	0	0
Second $\frac{1}{2}$ year's Interest .	63	0	0
Third Principal . .	1323	0	0
Third $\frac{1}{2}$ year's Interest .	66	3	0
Amount at end of $1\frac{1}{2}$ years	1389	3	0

Here the interest has to be added to the principal at the end of

each half-year for three half-years. The compound *interest* would be £1389 3*s*. – £1200 = £189 3*s*.

Of course the compound interest on a given principal is *greater* when the periods at the end of which the interest is to be added are *shorter*. Thus, the interest is more when payable half-yearly than when payable yearly.

In Compound as in Simple Interest, the principal, rate per cent., or time, may each be found when the other particulars are given. A knowledge of Algebra is however usually required. Examples like the following may be worked by Arithmetic.

(3) What sum will amount to £735 in two years at 5 per cent., compound interest?

Here it is required to find the principal; the amount, rate, and time being given.

First, find the amount of £100 at the given rate, and for the given time.

By the method given above, this will be found to be £110 5*s*.

The question now stands thus:—If £100 amount to £110 5*s*. at compound interest, how much will amount to £735 at the same rate and in the same time?

Therefore, by Rule of Three—

£	*s*.		£		£	£	*s*.	*d*.
110	5	:	735	::	100	:	666	13	4

The sum, or principal required, is therefore £666 13*s*. 4*d*.

Exercise 3.

(*Note*.—The following examples are all taken from Government Examination Papers.)

(1) Find the compound interest on £500 for 4 years, at 5 per cent. per annum.

(2) Compound interest of £270 in 2 years at 3 per cent. Answer to decimals of a penny.

(3) Find the compound interest on £254 in 3 years 5 months at 3 per cent. per annum.

(4) Find the compound interest of £265 for 3 years at 5 per cent. per annum.

(5) Find the compound interest on £200 for 3 years at 5 per cent.

(6) Find the compound interest and amount of £207 15*s.* for 2 years at 2½ per cent. per annum.

(7) What is the compound interest on £1200 for 3 years at 4 per cent. per annum? Give the answer to decimals of a penny.

(8) Find the compound interest on £4000 for 2½ years at 5 per cent. per annum.

(9) What is the compound interest of £5 for 5 years at 5 per cent.?

(10) Find the compound interest and amount of £49,000 for 3½ years at 7 per cent. per annum.

(11) In what time will £400 amount to £467 18*s.* 10·42*d.* at 4 per cent., compound interest?

(12) If the sum of £1200 be laid out at 10 per cent., compound interest, to what sum will it amount in a year and a half—(1) if the interest be paid yearly; (2) if it be paid half-yearly?

(13) What is the compound interest on £375 for 3 years at 5 per cent. per annum, interest payable half-yearly? Answer to 4 places of decimals only.

(14) If £100 be placed at interest at 5 per cent., and the interest be added to the principal every 20 years, in how many years will it amount to £1000?

At the end of 20 years the amount will be £200.
" 40 " " £400.
" 60 " " £800.

It now remains to find in what time (after the 60 years) £800 will amount to £1000 at simple interest (since the interest will not be added till the end of another 20 years).

(15) What sum, at 4 per cent. compound interest, will amount to £4,247 8*s.* 10·368*d.* in 2½ years?

(16) What sum of money must be invested to amount to

£122 19*s.* 8·13*d.* in 2 years at 5 per cent. per annum, compound interest.

(17) What is the compound interest on £1150 for 2½ years at 5 per cent?

(18) Find compound interest on £3600 for 2½ years at 5 per cent., interest payable half-yearly.

(19) What is the difference between the simple and compound interest of £13,333 6*s.* 8*d.* for 5 years at 5 per cent. per annum?

(20) Find the difference between the simple and compound interest on £3,600 for 3 years at 4½ per cent.

(21) Find the difference between the simple and compound interest on £1000 for 3 years at 5 per cent. per annum.

(22) B invested £1000 for 3 years at 5 per cent. *compound* interest. At what rate per cent. must A invest an equal sum for the same time, in order that he may obtain as much as B by *simple* interest?

(23) Compare the sum of money which will amount to £105 6*s.* 0½*d.* in 3½ years at 4½ per cent., simple interest, and the sum which, put out at compound interest for 2 years at 5 per cent., will amount to £100.

(24) The difference between the simple and compound interest of a certain sum of money for 3 years at 5 per cent. is £1. Find the sum.

This problem was given to Pupil Teachers for the end of the fifth year. The pupil should endeavour to solve it, if possible, without consulting the following notes.

Simple Interest on £100 for 3 yrs. at 5 per cent. = £15.
Compound „ „ „ „ = £15 15*s.* 3*d.*
∴ Difference for £100 „ = 15*s.* 3*d.*

The question now stands thus:—If the difference on £100 be 15*s.* 3*d.*, on what sum will the difference be £1?

Therefore, by Rule of Three,—

s.	*d.*	£		£		
15	3	1	::	100	:	Answer.

DISCOUNT.

Discount is an allowance or deduction made for the payment of money before it is due.

If I have to pay £100 to A at the end of six months from this time, it might be convenient to me, or to him, or to both of us, that I should discharge the debt *now*. In this case I should be entitled to have the amount I am liable for at the end of six months reduced, in consideration of my paying it before it is due. If he received £100 *now*, it is evident that he would get more than he had a right to receive, for by the end of the six months he would have obtained £100 + the Interest on £100 for six months. I should therefore have to pay, *not* £100, but the **Present Value** of £100. The difference between a sum of money due some time hence and its present value is the Discount.

In the case above referred to, it is evident that A would be entitled to such a sum as, together with the interest on it for six months, would amount to £100. Now, since the interest on £100 for 6 months at 5 per cent. is £2 10*s*., it is evident that the present value of £102 10*s*. due 6 months hence at 5 per cent., is £100; hence the Discount on £102 10*s*. due 6 months hence at 5 per cent. is £2 10*s*. Having now the Present Value and Discount of £102 10*s*., it would be easy, by the Rule of Three, to find the Present Value and Discount of £100, or of any other sum for the same time and at the same rate per cent.

Discount is generally allowed to bankers and others for cashing bills due at a certain future time. The market rate of discount varies from time to time according to the abundance or scarcity of money.

Bankers, in calculating discount, generally reckon simply the interest of the sum for the given time. This, however, is evidently not True Discount, though the difference is not very great. Thus, **True Discount** on a Bill of £102 10*s*. due 6 months hence, at 5 per cent., would be £2 10*s*., or the interest on £100 for the given time; **Bankers' Discount** would be the

interest on £102 10*s.* for the given time, which would be somewhat greater than the True Discount.

The pupil will now be able to understand the following examples.

(1) Find the present value of £1296, due 9 months hence, at £10 13*s.* 4*d.* per cent.

£10 13*s.* 4*d.* per cent. = 10⅓ per cent.

First, find the interest on £100 for 9 months at 10⅓ per cent.

Interest on £100 for 9 months at 10⅓ per cent. = £8.

Then, from the explanations given above, it follows that the present value of £108 is £100.

Therefore, by the Rule of Three, we can find the present value of £1296.

£ £ £ £
108 : 100 :: 1296 : 1200

Hence we have, Present Value = £1200
(And Discount = £96).

(2) What is the discount on £981 8*s.* 4*d.* for 97 days, at 3⅛ per cent. per annum?

Interest on £100 for 97 days at 3⅛ per cent. = 16*s.* 7$\frac{3}{7}$*d.*

∴ Present value of £100 16*s.* 7$\frac{3}{7}$*d.* = £100.

By Rule of Three.

£	*s.*	*d.*		£	£	*s.*	*d.*		£	*s.*	*d.*
100	16	7$\frac{3}{7}$	:	100	:: 981	8	4	:	973	6	8

∴ Present value of £981 8*s.* 4*d.* = £973 6*s.* 8*d.*

∴ Discount = £981 8*s.* 4*d.* — £973 6*s.* 8*d.* = £8 1*s.* 8*d.*

(3) A bill was drawn for £580 on January 12, at 5 months, and was discounted on April 3; find the discount at 6 per cent.

In England three "Days of Grace" are allowed after a bill becomes due; that is, a bill is not *legally* payable till three days after it is *nominally* payable. Bills falling due on Sunday are payable the Saturday previous. If a bill be drawn on January 31 for one month, it is nominally due on the *last* day of February; if for three months, on the *last* day of April; and so for any similar cases.

The bill referred to in Example 3 was drawn on January 12

at 5 months; it is therefore *nominally* payable on June 12, and *legally* on June 15. The bill was discounted on April 3; reckoning, therefore, from April 3 to June 15 (not including the former) we have 73 days for which to calculate discount.

Interest on £100 for 73 days at 6 per cent. = £1 4*s*.

∴ Present value of £101 4*s*. = £100.

By Rule of Three.

£	*s*.		£		£	*s*.	*d*.
101	4	: 580	::	100	: 573	2	$5\frac{103}{265}$.

∴ Present value of £580 = £573 2*s*. $5\frac{103}{265}$*d*.

∴ Discount = £580 − £573 2*s*. $5\frac{103}{265}$*d*. = £6 17*s*. $6\frac{159}{265}$*d*.

Exercise 4.

(*Note*.—The following examples are all taken from Government Examination Papers.)

(1) What is the discount on £757 1*s*., due 9 months hence, interest being reckoned at 4 per cent.?

(2) Find the discount on £132, payable at the end of 3 months, at $3\frac{1}{2}$ per cent. interest?

(3) Find the present worth of £10,500, due 15 months hence, at 4 per cent. simple interest?

(4) What is the present worth of £75, due 15 months hence, at 5 per cent.?

(5) What is the present value of £195,585, due 1 year 9 months hence, discount at 6 per cent. per annum?

(6) Find the present value of £598 9*s*. 9*d*., due at the end of 1 year 115 days, at $2\frac{1}{2}$ per cent.

(7) Find the present value of £605 10*s*. 6*d*., due 3 years hence, the rate of interest being £4 15*s*. per cent. per annum.

(8) Find the discount on a bill for £237 10*s*., due 4 months hence, at 4 per cent. simple interest. What would be the amount of the error if interest were taken instead of discount, and in whose favour would the error be?

(9) What is the difference between the present value of £750, due 9 months hence, at 5 per cent. per annum, and £720, due 2 months hence, at 3 per cent. per annum?

(10) A bill was drawn, March 13, for £325 10*s.*, at 9 months, and discounted July 23; find the discount at $3\frac{3}{4}$ per cent.

(11) What is the present worth of £120, payable as follows, viz.:—£50 at 3 months, £50 at 5 months, and the remainder at 8 months, allowing discount at the rate of 5 per cent.?

(12) A. offers for an estate £83,000 now, and B. £96,000 at the end of 3 years. Which is the better offer, and by how much, allowing 5 per cent. per annum compound interest?

(13) Received to-day (Sept. 29) £456 10*s.* for a debt of £490 14*s.* 9*d.*, discount 5 per cent. per annum. When should the debt have been payable without discount?

(14) If the present worth of £838, due at the end of 19 months, be £800, find the rate per cent. per annum.

(15) From a bill of £3 11*s.* 8*d.*, due 18 months hence, a tradesman deducts 5*s.* for ready money payment; what is the rate per cent. per annum at which this discount is calculated?

(16) If I am liable for a bill of £380, due 3 months hence, and I propose to pay at once, partly in cash and partly with a bill for £152, due 4 months hence, what sum must I pay down? (Interest reckoned at 4 per cent.)

PERCENTAGES.

There are many problems of a miscellaneous kind based on the consideration of a rate per cent. Questions of this kind are solved by the Rule of Three, as explained in the examples given below.

(1) What would be the purchase-money of an estate producing a rental of £3,223, at the rate of £2 15*s.* for every £100?

That is, at the rate of $2\frac{3}{4}$ per cent.

Now, £100 has to be given for every £$2\frac{3}{4}$ of rental, and we have to find how much must be given for £3,223 of rental.

Then, by Rule of Three.

£		£		£		£
$2\frac{3}{4}$	:	3223	::	100	:	117,200

∴ The purchase-money is £117,200.

(2) In a school of 1000 children, 24 per cent. are presented for examination in grammar, and of these $26\dot{6}$ per cent. fail. How many children *passed?*

24 per cent., means 24 out of each 100.

The question now stands thus: If 24 children were *presented* out of each 100, how many were presented out of 1000 (the whole school).

By Rule of Three.

100 : 1000 :: 24 : 240

∴ Number presented = 240.

Now, $26\dot{6}$ (= $26\frac{2}{3}$) per cent. failed.

That is, $26\frac{2}{3}$ out of each 100 presented failed.

Then, if $26\frac{2}{3}$ out of 100 failed, how many failed out of 240 (the whole number presented)?

By Rule of Three.

100 : 240 :: $26\frac{2}{3}$: 64

∴ No. who *failed* = 64.

∴ No. who *passed* = 240 − 64 = 176.

(3) Out of an invading army of 62,000 men 18·25 per cent. perished by fatigue and disease; 27·8 per cent. fell in action, and the remainder returned home safe. What percentage of the whole army escaped, and how many fell in action?

Percentage perished by fatigue, etc.	=	18·25
„ fell in action	=	27·8
∴ Total percentage lost	=	46·05
∴ Percentage escaped = 100 − 46·05	=	53·95.

We now have to find how many men fell in action.

Now, since 27·8 per cent. (that is 27·8 out of every 100) fell in action, we have to find by Rule of Three how many fell out of the whole army of 62,000.

100 : 62,000 :: 27·8 : 17,236

∴ No. of men who fell in action = 17,236.

(4) There sailed in an emigrant ship 280 men, $\frac{5}{7}$ of that num-

ber of women, and half as many children as men and women reckoned together; what percentage of men, of women, and of children were on board?

No. of men = 280
∴ No. of women = $\frac{5}{7}$ of 280 = 200
∴ No. of children = $\frac{1}{2}$ (280 + 200) = 240
∴ Total number on board = 720

We have the *number* of men, women, and children on board; we are now required to find the *percentage* of each, that is, the number of each out of every hundred persons on board.

Now, since we have 280 men out of a total of 720 persons, we can find by Rule of Three how many men there were out of each hundred persons.

720 : 100 :: 280 : $38\frac{8}{9}$
∴ Percentage of men = $38\frac{8}{9}$

Similarly,

720 : 100 :: 200 : $27\frac{7}{9}$
∴ Percentage of women = $27\frac{7}{9}$
720 : 100 :: 240 : $33\frac{1}{3}$
∴ Percentage of children = $33\frac{1}{3}$

Observe that $38\frac{8}{9} + 27\frac{7}{9} + 33\frac{1}{3}$ = 100 per cent.
which represents the whole number of persons on board.

Percentages sometimes take the form of **Commissions, Brokerages, Insurance Premiums**, etc., all of which are rates per cent. charged for effecting certain business transactions.

(5) If a broker be allowed $3\frac{1}{4}$ per cent., what may he demand when he sells goods to the value of £876 5*s.* 10*d.*

This question is simply; If the broker receives £$3\frac{1}{4}$ on £100 what will he receive on £876 5*s.* 10*d.*?

By Rule of Three.

£		£ *s.* *d.*		£ *s.*		£ *s.* *d.*
100	:	876 5 10	::	3 15	:	32 17 $2\frac{1}{2}$

∴ Brokerage = £32 17*s.* $2\frac{1}{2}$*d.*

Exercise 5.

(*Note.*—The following examples are all taken from Government Examination Papers.)

(1) The former population of a parish was 1775; now it is 1917. What has been the increase per cent.?

(2) A gardener sows a drill 44 yards in length with a quart of peas; the plant fails partly, and on transplanting he finds that he has a row of only 108 feet long. What does he lose per cent.?

(3) How much per cent. is (*a*) $2\frac{1}{2}d.$ in the shilling, and (*b*) 2*s.* 9*d.* in the £?

(4) If in a school of 360 children 27 play truant, and 63 are sick, what percentage of non-attendance is due to truancy and to sickness respectively?

(5) If the proportion of nitrogen in the air is 79 per cent., and of oxygen 20 per cent., what quantity of nitrogen and oxygen respectively will there be in an apartment containing 908,500 gals. of air?

(6) If the atmosphere contains ·0004 per cent. of carbonic acid gas, what quantity of that gas ought there to be in a hall 80 ft. by 40 ft. and 35 ft. high?

(7) A cask of rum, containing 78 gallons, leaked 29 per cent. What quantity remained in the cask?

(8) If the population of the globe be eleven hundred millions of souls, and 3,300,000 of these be Jews, 172,700,000 Mahometans, and 337,700,000 Christians, what is the percentage of each?

(9) If gunpowder consists of 75 parts of nitre, 10 parts of sulphur, and 15 parts charcoal, what weight of each ingredient will there be in 15 cwt. of gunpowder?

(10) A school consists of 97 boys, 108 girls, and 145 infants. How many children are assembled on a day when there are only 18 per cent. absent?

(11) A clock, just set, goes ·04 per cent. too slow. How many days must elapse before it will show correct time again?

In order to show correct time again, it is necessary that the clock should lose 12 hours, that is, the time shown by the whole circle of the dial.

Now, in 1 day (24 hrs.) the clock loses ·04 per cent. of 24 hrs.
That is, it loses ·08 per cent. of 12 hours.

The question then is, in how many days will the clock lose 100 per cent. (the whole) of 12 hours. Hence we have the following proportion :—

day
·08 : 100 :: 1 : Answer.

(12) A grocer uses for a lb. weight one which weighs only 15·75 oz. To what extent per cent. are his customers defrauded?

(13) A man who has a house worth £2000 insures it at $\frac{3}{5}$ of its value, at 3*s.* 4*d.* per cent. What does his yearly premium amount to?

(14) A broker procures an assurance on property to the amount of £1850; what will he have for his trouble at 3*s.* 9*d.* per cent.?

(15) If a tradesman takes off $9\frac{5}{11}$ per cent. for ready money payment, what should he be willing to accept down for a bill of £81 5*s.*?

(16) What must be paid yearly on an insurance for £9626 11*s.* 3*d.* at £2 12*s.* per cent.?

(17) A cask which originally contained 20 gals. had leaked 10 per cent. How often might a vessel holding $3\frac{3}{8}$ gills be then filled from it?

(18) If a collector who is paid 5 per cent. commission receives £17 10*s.* for his trouble, how much has he collected?

(19) A house which cost £1500, lets for £65 a year; the outgoings for insurance and other expenses amount to $1\frac{1}{4}$ per cent. on its cost. What rate of interest does it pay?

(20) A rent collector, after deducting his commission of $3\frac{3}{4}$ per cent., paid to his employers £1203 2*s.* 6*d.* What was the total amount of the rents collected?

(21) The standard height for enlistment being 5 ft. 5 in., out of 1950 recruits 748 were under 5 ft. 6 in., 500 between 5 ft. 6 in. and 5 ft. 7 in., 429 between 5 ft. 7 in. and 5 ft. 10 in., 273 were 5 ft. 10 in. and upwards. What percentage of the recruits would have been rejected if the standard had been raised to 5 ft. and what percentage if to 5 ft. 10 in.?

(22) A newspaper contains 48 columns, averaging 100 lines in each, $8\frac{1}{2}$ words in each line, $4\frac{1}{4}$ letters in each word; what number of consonant letters will be required to print the paper if the vowels are 35 per cent.?

(23) 5 per cent. on a given sum yields £3·770$8\dot{3}$; give $5\frac{1}{4}$ per cent. on half that sum in £ *s.* *d.*

(24) A merchant invested £3480 in his business; the first year he lost 5 per cent., next year he gained 4 per cent., and the third year he gained 1·5 per cent. What was the amount of his capital at the end of the third year?

STOCKS.

By **Stock** is meant money lent to some Government or Trading Company and bearing a fixed rate of interest; or which is invested in some public or private undertaking in order to receive a dividend or share in the profits according to the amount invested.

The English Government owes a large sum of money, called the **National Debt**, or the **Funds**. On this money interest at the rate of 3 per cent. is paid half-yearly. This debt is owed to a large number of individuals, who are able to sell their claims on the Government to other persons. It is spoken of in the money market as Government Stock, or **Consols**, and is bought and sold at so much per £100 of Stock.

In the same way, foreign Governments have borrowed money at various rates of interest, and their Stock is bought and sold in the money markets.

Similarly, shares in Railway, Telegraph, and other Companies are bought and sold.

The prices of various Stocks and Shares vary from day to day, according to the various circumstances which affect their value, either favourably or adversely, such as the abundance or scarcity of money, the state of trade, the amount of success companies have met with in their business, etc.

A country or company which inspires confidence in com-

mercial circles by having a reputation for stability or honesty, can borrow money at a lower rate of interest than one of which a lower opinion is entertained.

The nominal and actual values of one hundred pounds' worth of Stock often differ widely. Its marketable value *may* be exactly £100; it is then said to be at *par*. If its actual value be over £100, it is said to be at a *premium*; and if below £100, it is said to be at a *discount*.

The learner should most carefully observe the distinction between the Stock itself (its *nominal* value) and the money it is really worth (its *actual* value), or that which it would realize if sold.

Thus, when Consols are quoted at 95, that means that £100 English Government Stock is worth in the market £95. The interest is paid on the nominal value of the Stock. Thus, if I bought £100 Consols for £95, I should receive £3 per annum interest.

Dealings in Stocks and Shares are usually transacted through brokers, who generally charge a **Commission** of 2*s.* 6*d.*, or one-eighth, per cent. on the amount of Stock dealt in.

When this Commission, or Brokerage, has to be taken into account in any of the following examples, it will be expressly specified.

Problems in Stocks are solved by means of the Rule of Three, as explained in the examples which follow.

(1) What sum must be invested in $3\frac{1}{2}$ per cent. Stock to purchase an annuity of £100 per annum, the Stock being at $93\frac{1}{8}$?

£100 Stock costs £$93\frac{1}{8}$;

and the interest of £100 Stock is £$3\frac{1}{2}$ per annum.

∴ £$93\frac{1}{8}$ will produce £$3\frac{1}{2}$ per annum.

We now have to find how much money will produce £100 per annum.

By Rule of Three.

£		£		£		£	*s.*	*d.*
$3\frac{1}{2}$	:	100	::	$93\frac{1}{8}$	:	2666	13	4

∴ Sum required = £2666 13*s.* 4*d.*

(2) At what rate must I invest £60 to obtain the yearly sum of £3 12*s.*?

Here £60 has to produce £3 12*s.* per annum.

The question therefore is, what is the rate per cent.? that is, how much would £100 produce?

By Rule of Three.

£		£		£ *s.*		£
60	:	100	::	3 12	:	6

The rate is therefore 6 per cent.

(3) A man invests £1585 10*s.* in 3 per cents. at 94¼, brokerage is charged at the rate of ⅛ per cent.; what income does he derive?

Every £100 Stock produces £3 per annum.

„ costs £(94¼ + ⅛) = £94⅜.

∴ £94⅜ produces £3 per annum.

The question now is, how much per annum will £1585½ produce?

By Rule of Three.

£		£		£		£	*s.*
94⅜	:	1585½	::	3	:	£50	8

∴ Income = £50 8*s.*

(4) What rate of interest arises from money invested in the 7 per cents. at £175?

Here every £100 Stock produces £7 per annum.

And „ costs £175.

∴ £175 produces £7 per annum.

We now have to find the rate per cent.; that is, how much £100 produces. Then, by Rule of Three,

£		£		£		£
175	:	100	::	7	:	4

∴ £100 produces £4 per annum.

That is, the rate of interest is 4 per cent. on the money invested.

(5) In which Stock is it more advantageous to invest; in the 3¼ per cents. at 91⅜, or in the 3½ per cents. at 93⅝? How much Stock may be purchased by investing £1000 in each?

In the 3¼ per cents. £91⅜ produces an income of £3¼.

Now, we must find how much £91⅜ produces in the 3½ per cents.

Since 93⅜ produces £3½,

Then, by Rule of Three,

£ £ £ £

$93\frac{3}{8} : 91\frac{3}{8} :: 3\frac{1}{2} : 3\frac{59}{131}$

∴ In the 3½ per cents. £91⅜ produces an income of £$3\frac{59}{131}$.

Comparing the two incomes produced by the same sum of money in the two different Stocks, we find that the income produced in the 3½ per cents. is the greater; that is, it is the more advantageous to invest in.

Again, in the 3¼ per cents., since 91⅜ purchases £100 Stock,

Then, by Rule of Three,

£ £ £ £

$91\frac{3}{8} : 1000 :: 100 : 1094\frac{66}{131}$.

That is, £1000 purchases £$1094\frac{66}{131}$ Stock at 3¼ per cent.

And, in the 3½ per cents, since £93⅜ purchases £100 Stock,

Then, by Rule of Three,

£ £ £ £

$93\frac{3}{8} : 1000 :: 100 : 1068\frac{68}{749}$

That is, £1000 purchases £$1068\frac{68}{749}$ Stock at 3½ per cent.

(6) A person invests £4800 in the 4 per cents. at 80, and at the end of each year invests the dividend which becomes due in the same Stock at the same price. Find his dividend at the end of the third year.

Since £100 Stock costs £80,

£4800 will purchase £6000 Stock.

∴ Dividend at end of 1st year = interest on £6000 at 4 per cent. for one year = £240.

And £240 will purchase £300 Stock at £80.

∴ Total amount of Stock in 2nd year = £6300.

∴ Dividend at end of 2nd year = interest on £6300 at 4 per cent. for one year = £252.

And £252 will purchase £315 Stock at 80.

∴ Total amount of Stock in 3rd year = £6300 + £315 = £6615.

∴ Dividend at end of 3rd year = interest on £6615 at 4 per cent. for one year = £264 12*s*.

(7) A person invests £1037 10*s*. in the 3 per cents. at 83, and when the funds have risen 1 per cent. he transfers his capital to the 4 per cents. at 96; find the alteration in his income.

£83 will purchase £100 Stock.
∴ £1037 10*s*. will purchase £1250 Stock.
Income from this Stock, at 3 per cent. = £37 10*s*.
He sells each £100 Stock for £84.
∴ He sells £1250 Stock for £1050.
He buys again at the rate of £96 per £100 Stock.
∴ For £1050 he purchases £1093$\frac{3}{4}$ of this Stock.
This Stock pays 4 per cent. interest.
∴ Income from this Stock = £43 15*s*.
Subtract 1st income £37 10*s*.
∴ Alteration in his income = £ 6 5*s*. increase.

Exercise 6.

(*Note.*—The following examples are all taken from Government Examination Papers.)

(1) When the 3 per cents. are at 91$\frac{1}{4}$, what amount of Stock can I buy for £1835? and what rate of interest shall I get for my capital?

(2) What must be given for £5050 Stock in the 3 per cents. at 85$\frac{3}{8}$ per cent.?

(3) How much money must a person invest in the 3 per cents. when the price of Stock is 90$\frac{3}{8}$ per cent., in order that his half-yearly income may equal £50?

(4) If I invest £1200 in the 3 per cents. at 72, what is my income? and how much per cent. do I get for my money?

(5) What is the price of the 3$\frac{1}{2}$ per cents. when £3930 invested in them produces £130 per annum?

(6) How much Stock can be purchased for £3116 5*s*. in the 3$\frac{1}{2}$ per cents. standing at 103$\frac{7}{8}$? What income will it yield?

(7) What *percentage* and what *amount* of interest will an investor receive who puts his capital, £19,500, into the 3 per cents., standing at £89$\frac{7}{8}$, commission being $\frac{1}{8}$ per cent.?

(8) Find the yearly income from investing £3960 in Railway Stock standing at 103, and paying $5\frac{1}{4}$ per cent. (brokerage being $\frac{1}{8}$ per cent.)

(9) Find the yearly income arising from £6040 in the 3 per cent. Consols selling at $94\frac{3}{8}$ per cent.

(10) Find the selling price of the 3 per cent. Consols when an outlay of £3020 produces a yearly income of £96.

(11) I sold out of the 3 per cents. at 96, and invested the sum accruing in railway 5 per cent. Stock, thereby increasing my income 50 per cent. What was the price of the Railway Stock?

(12) What amount of 7 per cent. Stock at $106\frac{1}{2}$ will £585 15*s.* purchase, and what will be the interest upon it?

(13) How much must I invest in the 3 per cents. at $91\frac{1}{4}$, in order to have an income of £150 10*s.* a year?

(14) A capitalist invests £5187 10*s.* in the 3 per cents. at 83; he transfers $\frac{2}{3}$ of this sum to the 4 per cents. at 96. Find the alteration in his income.

(15) What is the yearly interest on £27,225 bought into the $3\frac{1}{4}$ per cents. at $97\frac{1}{2}$?

(16) Which is the better Stock for investment, the $3\frac{1}{4}$ per cents. at $92\frac{5}{8}$, or the $3\frac{1}{2}$ per cents. at par?

(17) If a person invest in 4 per cent. Stock at $77\frac{1}{2}$, at what rate per cent. will he receive interest for his money?

(18) What must be the market value of 3 per cent. Stock, so that, after deducting an income-tax of 10*d.* in the £, it may yield $3\frac{1}{2}$ per cent. interest?

(19) What sum of money must be invested in the $5\frac{1}{2}$ per cent. Stock at 83 to enable the possessor to realize an income of £64 3*s.* 4*d.* per calendar month?

(20) What price are the $3\frac{1}{2}$ per cents. at when a man buys Stock producing £17 10*s.* a year for £401 13*s.* 4*d.*?

(21) The 3 per cents. standing at $98\frac{1}{2}$, what sum must be invested in them to produce an *annual* income equal to the whole interest on £500 for 14 years at $2\frac{1}{2}$ per cent.?

(22) If I invest £650 in the 3 per cents. at $92\frac{1}{8}$, and sell out when they have fallen to $91\frac{1}{2}$, what shall I lose by the transaction?

(*Note.*—On £92$\frac{1}{8}$ he loses £$\frac{5}{8}$; it is required to find how much he loses on £650.)

(23) A speculator buys shares when they are at 19$\frac{1}{2}$, £15 having been paid up, and sells them again at £32 9*s.* when £25 has been paid up. How much per cent. does he gain or lose?

(24) A speculator invests £4800 in 4 per cents. at 80, and at the end of each year invests the dividend due in the same Stock. If the funds remain at 80 for 3 years, find his dividend at the end of the third year.

PROFIT AND LOSS.

This subject includes questions which refer to the gain or loss made by merchants in commercial transactions, whether calculated in money or in rate per cent.

Questions of this kind are solved by the ordinary rules of arithmetic. They are based on the consideration of two things, (*a*) **the Cost price,** (*b*) **the Selling price.**

(1) Bought 76 yards of muslin at 11*s.* 8*d.* per yard; sold it at 14*s.* 2*d.* per yard. What was the gain upon the whole?

Gain per yard = 14*s.* 2*d.* — 11*s.* 8*d.* = 2*s.* 6*d.*

∴ Whole gain = 2*s.* 6*d.* × 76

= £9 10*s.*

(2) If tea be bought at £·1 per lb., and sold at ·1 of a guinea, what is the gain per cent.?

Cost price = £·1 = £$\frac{1}{10}$ = 2*s.*

Selling price = ·1 of a guinea = $\frac{1}{9}$ of 21*s.* = 2*s.* 4*d.*

∴ Gain = 2*s.* 4*d.* — 2*s.* = 4*d.*

∴ Gain on 2*s.* = 4*d.*

We have now the gain on 2*s.*, and it is required to find the gain per cent.; that is, the gain on £100.

By Rule of Three.

s.		£		*d.*		£	*s.*	*d.*
2	:	100	::	4	:	16	13	4

∴ Gain per cent. = £16 13*s.* 4*d.*, or 16$\frac{2}{3}$.

(3) For how much must an article be sold which costs £12 10*s.* in order to gain 15 per cent.?

On £100 the gain is £15.

Therefore an article bought at £100 must be sold for £115.

That is, when the cost price is £100 the selling price is £115.

We now have to find the selling price when the cost price is £12 10*s.*

By Rule of Three.

£		£ *s.*		£		£ *s.* *d.*
100	:	12 10	::	115	:	14 7 6

∴ The article must be sold for £14 7*s.* 6*d.*

(4) A man sells a pig to a neighbour for 19*s.* 3*d.*, gaining thereby 12 per cent. on what he gave for it. How much did he give?

Here we have the *selling price* given us.

It is required to find the *cost price.*

Since the gain is at the rate of 12 per cent., it is evident that if the cost price had been £100 the selling price would have been £112. That is, if the selling price were £112, the cost price would be £100. Having then the cost price of articles sold for £112, we can, by Rule of Three, find cost price of the pig sold for 19*s.* 3*d.*

£		*s.* *d.*		£		*s.* *d.*
112	:	19 3	::	100	:	17 $2\frac{1}{4}$

∴ Cost price of pig = 17*s.* $2\frac{1}{4}$*d.*

(5) If a tradesman, by selling an article at 8*s.* 3*d.*, loses $17\frac{1}{2}$ per cent., what should he have sold it for to gain 40 per cent.?

Since the loss was at the rate of $17\frac{1}{2}$ per cent., if the cost price had been £100 the selling price would have been £$82\frac{1}{2}$. Hence, as in Example 4, we find the cost price—

£		*s.* *d.*		£		*s.*
$82\frac{1}{2}$	:	8 3	::	100	:	10

∴ Cost price = 10*s.*

Now, it is required to gain 40 per cent.

∴ If the cost price be £100, the selling price must be £140.
Therefore, by Rule of Three (as in Example 3),—

£	s.		£	s.
100	: 10	::	140	: 14.

∴ Price at which he should have sold it = 14*s.*

(6) A grocer buys sugar at 7*d.* and at 10*d.* per lb., and mixes them in the proportion of 3 : 5; what will he gain or lose per cent. if he sells the mixture at 9*d.* per lb.?

In every 8 lb. of mixture there is 3 lb. of the cheaper sort (at 7*d.* per lb.), and 5 lbs. of the dearer sort (at 10*d.* per lb.).

∴ Cost price of 8 lbs. of mixture = 3 × 7*d.* + 5 × 10*d.*
= 5*s.* 11*d.*

And selling price of 8 lbs. of mixture = 9*d.* × 8 = 6*s.*

∴ Gain on 5*s.* 11*d.* = 6*s.* − 5*s.* 11*d.* = 1*d.* = £$\frac{1}{240}$.

It is required to find gain on £100 (= gain per cent.).

By Rule of Three.

s.	d.		£	£
5	11 :	100	:: $\frac{1}{240}$	: $1\frac{2}{71}$.

∴ Gain per cent. = $1\frac{2}{71}$.

Exercise 7.

(*Note.*—The following examples are all taken from Government Examination Papers.)

(1) If coal is purchased at the pit's mouth for 10*s.* a ton, and its carriage costs 5*s.*, at what price should it be sold to realize a profit of 25 per cent.?

(2) If by selling tea at 6*s.* 4*d.* per lb. a grocer loses 6 per cent., what did it cost him per lb.?

(3) If tea be bought at the rate of £24 10*s.* for a box containing $1\frac{1}{2}$ cwt., and be sold at 3*s.* 7*d.* per lb., what is the gain per cent.?

(4) I lost $18\frac{3}{4}$ per cent. on the sale of a horse for which I had given £118 15*s.*; what did I get for him?

(5) How must nutmegs, which cost 18*s.* 9*d.* per lb., be sold in order to gain 16 per cent.?

(6) I gained 4 per cent. by selling an article for £$\frac{3}{5}$. How much should I have gained by selling it for £$\frac{3}{4}$?

(7) Suppose that a reduction of 15 per cent. in a man's wages causes him to lose eighteenpence weekly, what were his weekly wages before the reduction?

(That is, if 15 per cent. of his wages was 1*s.* 6*d.*, what was the *whole* of his wages, viz., 100 per cent.?)

(8) Cheese bought at 50*s.* per cwt. is sold at 6$\frac{1}{2}$*d.* per lb. What is the gain per cent.?

(9) If 1$\frac{1}{2}$ cwt. of tea is sold at a profit of 20 per cent. for £37 16*s.*, what was its cost price per lb.?

(10) A butcher contracts to supply a regiment with 100 cwt. of beef at 5$\frac{1}{2}$*d.* per lb.; what will be his gain per cent. if he can procure the meat for £2 a cwt.?

(11) What was the cost price of an article which, when sold for £90, realized a gain of 20 per cent.?

(12) If a man gains 5*s.* 6*d.* on goods sold by him for 22*s.*, what does he gain per cent.?

(13) By selling an article for 19*s.* I lose 5 per cent. What price should it have fetched to clear 12$\frac{1}{2}$ per cent.?

(14) I exchange $\frac{1}{2}$ cwt. of sugar at 4$\frac{1}{2}$*d.* per lb. for 7 lbs. of tea at 3*s.* 6*d.* per lb. What is my gain or loss per cent.?

(15) I gained 33 per cent. by selling lace at 13*s.* 6*d.* a yard; what was gained per cent. in selling it at 12*s.* a yard?

(16) A woman bought eggs at 9 for 6*d.* and sold them at 19*d.* a score. Her profits came to 2*s.* 10*d.* How many eggs did she sell, and what did she gain per cent.?

(17) If a woman's profits are ·3125 of her whole receipts, what was the cost price of a lot of eggs for which she received 14*s.*?

The profits are ·3125 of 14*s.*

∴ Cost price = 14*s.* − ·3125 of 14*s.*

(18) Bought a quantity of quills at 4*s.* 7*d.* a hundred, and sold them so as to gain $\frac{3}{8}$ of the *selling price*. What was the selling price, and what was the profit per cent. on the cost price?

(19) A man sold a quantity of snuff for £50, and, by so doing,

lost $33\frac{1}{3}$ per cent. What sum should he have sold it for to gain $2\frac{11}{40}$ times what he had given for it?

(20) I bought 18 cwt. 3 qrs. 24 lbs. of saltpetre, at £1 6*s.* 10*d.* per cwt., and sold a half of it at 3*d.* a lb., and the other half of it at £1 3*s.* 4*d.* per cwt. How much per cent. did I gain or lose, and how much money altogether?

(21) I bought 100 cards for 9*s.* 2*d.* and sold the lot so as to gain $\frac{3}{8}$ of the selling price. Find the selling price and my gain per cent.

(22) If the price of beef in London be 11*d.* a lb. and 40 per cent. less in America, and if the cost of transport be $\frac{3}{8}$*d.* per lb., at what price could American beef be sold in London, so as to realize 25 per cent. profit to the importer? and what would be the saving per cent. to the consumer at that price?

(23) Which is the cheaper, a hat which costs 15*s.*, and will last 9 months, or one which costs 12*s.*, and will last 7 months? And how much will a man save in 20 years who wears the cheaper kind of hat, interest not being reckoned?

(24) If 236 yds. of cambric are bought at 7*s.* $10\frac{1}{2}$*d.* per yard, and sold one-fourth at 10*s.* 3*d.*, one-third at 8*s.* 6*d.*, and the remainder at 7*s.* per yard, what will be the loss or profit per cent. on the whole outlay?

(25) Having bought goods for £20, I sell half of them so as to gain 10 per cent.; for how much must I sell the remainder so as to gain 20 per cent. on the whole?

MISCELLANEOUS.

Exercise 8.

(*Note.*—These examples are all taken from Government Examination Papers.)

(1) Find the average age (in years) of the boys in a school of 25 boys, one of whom is 17 years old; two 16; four $15\frac{1}{2}$; one $14\frac{3}{4}$; five $13\frac{3}{4}$; ten $12\frac{1}{4}$, and two 10 years.

1	at	17 years	=	17
2	„	16 „	=	32
4	„	$15\frac{1}{2}$ „	=	62
1	„	$14\frac{3}{4}$ „	=	$14\frac{3}{4}$
5	„	$13\frac{3}{4}$ „	=	$68\frac{3}{4}$
10	„	$12\frac{1}{4}$ „	=	$122\frac{1}{2}$
2	„	10 „	=	20

Total number of years = 337.

No. of boys = 25.

∴ Average age = 337 ÷ 25 = $13\frac{12}{25}$ years.

(2) A mechanic paid at the rate of 5*d.* per hour, does 7 hours' work on Monday, 11 on Tuesday, $9\frac{1}{2}$ on Wednesday, and $11\frac{1}{2}$ on Thursday. What are his *average* earnings per day?

(3) A ship has 5 masts; the height of one is 72 ft., of two others 63 ft., of the fourth 42 ft. What is the height of the fifth mast, if the average height of the five is 58 ft.?

(4) If $6\frac{1}{2}$ million visitors entered the Crystal Palace in 26 weeks, what was the average attendance per day?

(5) The population of three towns in 1851 was 20,325, 42,405, and 1423; and in 1861 they had increased respectively 9, 10, and 12 per cent. Find the average population of the three towns in 1861.

(6) What is the average income of 5 persons, of whom A gets the interest of £15,520 in $3\frac{1}{2}$ per cents. standing at par; B, 2*s.* 6*d.* a day; C, a guinea a week; D, $\frac{19}{20}$ of £5 a calendar month; E, £1000 a year?

(7) The population of five parishes being 1236, 452, 364, 516, 3430 respectively; find what the population of a sixth parish must be, that the average population of the six may be 1256·5.

(8) An estate in the Highlands contains 5 square miles, of which 1800 acres are under cultivation, yielding a rent of £1361 5*s.* per annum; 1000 acres are moorland, let at 5*s.* $10\frac{1}{2}$*d.* per acre, and the remainder is unproductive; what is the average income per acre derived from the estate?

(9) £1280 is divided among 3 persons, so that their portions are as 5, 3, 2 respectively. How much does each receive?

The operation by which problems of this kind are solved is usually called **Division into Proportional Parts**; but it is really only an application of the Rule of Three.

Since the 1st part is represented by 5
the 2nd „ „ 3
and the 3rd „ „ 2
∴ The whole money is represented by $5 + 3 + 2 = 10$.
∴ £1280 is represented by 10.

∴ Since the 1st part is represented by 5, it may be found by the following Proportion :—

£
10 : 5 :: 1280 : 1st part.

Similarly,

£
10 : 3 :: 1280 : 2nd part.

And also,

£
10 : 2 :: 1280 : 3rd part.

Working out these Proportions, we find that :—

1st person's share = £640
2nd „ = £384
3rd „ = £256.

(10) Three persons advanced £14,280 for business in the several proportions of 4, 5, 6; the gain is £872 10s. What amount of capital and gain belongs to each?

(11) A man owes £110 to A, £97 to B, and £133 to C; his assets are £85. What dividend will each receive?

(12) Divide 80 guineas among 3 persons, A, B, and C, so that their shares may be as $7\frac{1}{3}$, $10\frac{1}{3}$, $14\frac{1}{3}$ respectively.

As in Example 9, the whole 80 guineas is represented by $7\frac{1}{3} + 10\frac{1}{3} + 14\frac{1}{3} = 32$.

And the shares may be found by the three porportions

Guineas.

32 : $7\frac{1}{3}$ :: 80 : A's share
32 : $10\frac{1}{3}$ :: 80 : B's „
32 : $14\frac{1}{3}$ :: 80 : C's „

Working out these proportions, we have—

A's share = £19 5*s.*
B's „ = £27 2*s.* 6*d.*
C's „ = £37 12*s.* 6*d.*

(13) A legacy of £2979 12*s.* 6*d.* was left to four heirs, in the proportion of $\frac{1}{6}$, $\frac{3}{5}$, $\frac{4}{5}$, and $\frac{1}{3}$ respectively. Find the share of each.

The legacy was divided in proportions of $\frac{1}{6}$, $\frac{3}{5}$, $\frac{4}{5}$, and $\frac{1}{3}$,
That is, in proportions of $\frac{15}{90}$, $\frac{54}{90}$, $\frac{40}{90}$, and $\frac{30}{90}$,
Hence the shares are as 15, 54, 40, and 30,
And the problem may be solved as in Example 9.

(14) Divide a legacy of £2375 4*s.* 2*d.* among a son, a wife, and a daughter, so that the son's share shall be three times the wife's, and the wife's three times the daughter's.

If we let 1 represent the daughter's share,
Then 3 represents the wife's „
And 9 represents the son's „

(15) Divide 2856 into two parts, in the proportion of $\cdot\dot{2}$ and $\cdot\dot{3}\dot{4}$.

(16) Three persons make a joint stock: A puts in £184 10*s.*, B £96 15*s*, C. £76 5*s.*; they gain by trade £220 12*s.*; what is each person's share of the gain?

(17) A tax of £530 is to be raised from three towns, the number of inhabitants of which are respectively 2500, 3000, and 4200. How much should each town pay, and each person in it?

(18) Divide 7872 into three parts, so that the first shall be four times the second, and the second three times the third.

(19) Divide £11,000 among four persons, A, B, C, D, in the proportion of $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{5}$.

(20) A field of grass is rented by two persons for £27; the former keeps in it 15 oxen for ten days, and the latter 21 oxen for seven days: find the rent paid by each.

Here the rent paid by each must be in proportion both to the *number* of oxen kept in the field, and to the *time* they were kept there by each.

Hence, the numbers representing each person's share will be

found by multiplying the number of his oxen by the number of days they were kept in the field.

∴ 1st person's share is represented by $15 \times 10 = 150$,

and 2nd " " " " $21 \times 7 = 147$.

(21) If a partnership be formed between A, with a capital of £300, and B with a capital of £500, and at the end of 6 months they take in C with a capital of £800; how should a profit of £700 be divided at the end of the year?

(22) Divide 16*s.* 8½*d.* among A, B, C, D, so that A's share be $\frac{3}{10}$ of D's, C's share $\frac{3}{10}$ of A's, and B's share the sum of A's and C's. What should each receive?

Let D's share be represented by 1.

Then A's share is represented by $\frac{3}{10}$,

C's " " " $\frac{3}{10}$ of $\frac{3}{10} = \frac{9}{100}$,

And B's " " " $\frac{3}{10} + \frac{9}{100} = \frac{39}{100}$.

Exercise 9.

(*Miscellaneous Examples.*)

Note.—These examples are all taken from Government Examination Papers.

(1) If 64 yards of carpet 3 qrs. wide cover a floor, how much of 5 qrs. wide will be sufficient?

(2) A loan of £1,000 is paid in instalments as follows:—$\frac{1}{4}$ in 6 months, $\frac{1}{6}$ in 12 months, and the rest at the end of 2 years; what is the total interest which should be paid at 5 per cent.?

(3) A can complete a piece of work in 6 days, and B can complete it in 8 days; in what time will they finish it by working together?

(4) If two persons buy 1 lb. of tea, and one pays 2*s.* 11½*d.* for $\frac{5}{9}$ of it; how many ounces does the other get, and what does he pay?

(5) Find the weight of 4 packages, of which one is ·276 ton, another ·625 cwt., a third 75·8 lb., and the fourth 1·96 qr.

(6) Divide 576·58 guineas among 3 men and 4 women, giving each man 1·75 of a woman's share.

Since, for the purposes of this distribution, each man is equivalent to 1·75 woman—

$\therefore$ 3 men are equivalent to $3 \times 1{\cdot}75$ woman $= 5{\cdot}25$ women

$\therefore$ 3 men + 4 women are equivalent to $9{\cdot}25$ women

$\therefore$ Each woman's share $= 576{\cdot}58 \div 9{\cdot}25$ guineas

$= 62\frac{308}{925}$ guineas

$\therefore$ Each man's share $= 62\frac{308}{925} \times 1{\cdot}75$ guineas

$= 62\frac{308}{925} \times 1\frac{3}{4}$ guineas

$= 109\frac{183}{1850}$ guineas.

(7) What decimal multiplied by 125 will give the sum of $\frac{3}{8}$, $\frac{2}{5}$, and 2·46?

(8) Find the price of 28·6 stone of butter at 16*s.* 9½*d.* for 1·75 stone.

(9) How long must £7,200 be lent at 4 per cent. to amount to £9,760?

(10) A wall that is to be built 27 feet high was raised 9 feet by 12 men in 6 days; how many men must be employed to finish the wall in 4 days at the same rate of working?

(11) If 20 men can do a piece of work in 12 days, find the number of men who could perform another piece of work three times as great in $\frac{1}{3}$th of the time.

(12) The owner of $\frac{4}{17}$ of a ship sold $\frac{3}{11}$ of $\frac{2}{5}$ of his share for £12$\frac{4}{35}$. What would $\frac{2\frac{1}{3}}{4\frac{1}{4}}$ of $\frac{2}{5}$ of it cost at the same rate?

(13) If 4 per cent. be lost by selling linen at 2*s.* 9*d.* a yard, at what price must it be sold to gain 10 per cent.?

(14) If eggs be bought at 5 for threepence, at what price must they be sold to gain 20 per cent.?

(15) A can reap a field in 5 days and B in 6 days, working 11 hours a day; in what time could A and B together reap it, working 10 hours a day?

In 1 day A can reap $\frac{1}{5}$ of the field

$\therefore$ In 1 hour A can reap $\frac{1}{5} \div 11 = \frac{1}{55}$ of the field

In 1 day B can reap $\frac{1}{6}$ of the field

$\therefore$ In 1 hour B can reap $\frac{1}{6} \div 11 = \frac{1}{66}$ of the field

$\therefore$ In 1 hour A and B can reap $\frac{1}{55} + \frac{1}{66} = \frac{1}{30}$ of the field

$\therefore$ In 1 day of 10 hours A and B can reap $\frac{10}{30} = \frac{1}{3}$ of the field

$\therefore$ No. of days required $= 1 \div \frac{1}{3} = 3$.

(16) The population of three towns in 1851 was 20,325, 42,405, and 1,423; and in 1861 they had increased respectively 9, 10, and 12 per cent. Find the average population of the three towns in 1861.

(17) If the sun moves through 360° in 365 days 5 hrs. 48 min., how many minutes and seconds will he pass through in a day?

(18) If 90,876 articles were purchased at an average price of £5 12*s.* 6*d.* per dozen, what would be the total gain by charging 2½*d.* additional for each of them, and the gain per cent.?

(19) Divide 1080 by ·008, and ·084035 by 34·3, and find the difference between the two results.

(20) If I must hire 2 men + 3 boys for 6 days to do the same piece of work as 11 men and 5 boys could do in 1½ day, compare the work of a boy with that of a man.

Since 11 men + 5 boys can do the work in 1½ days, and 2 men + 3 boys can do the work in 6 days, therefore the latter require 4 times as long as the former; and hence it is evident that

$$11 \text{ men} + 5 \text{ boys} = 4(2 \text{ men} + 3 \text{ boys})$$
$$= 8 \text{ men} + 12 \text{ boys}.$$

From each side of this equality subtract 8 men + 5 boys, and the remainders will be equal

$$\therefore 3 \text{ men} = 7 \text{ boys}$$
$$\therefore \text{the work of a boy} : \text{that of a man} :: 3 : 7.$$

(21) A barrel containing 300 gallons is emptied by a tap which discharges 60 gallons per minute, in the same time as another barrel is emptied by a tap which discharges 10 gallons per minute; how much does the second barrel contain?

(22) Find what decimal of a guinea is equivalent to ·376 of a £ sterling.

(23) A ship was worth £14,000, and a person who owned ⅔ of it sold ¾ of his share; what part of the ship then belonged to him, and how much was it worth?

(24) Divide £64 among A, B, and C, so that A may have three times as much as B, and that C may have one-third of what A and B have together.

Let 3 represent A's share
Then 1 will represent B's share
and $\frac{3+1}{3} = \frac{4}{3}$ will represent C's share.
$\therefore$ the shares will be :: 3 : 1 : $\frac{4}{3}$
or :: 9 : 3 : 4
And $9 + 3 + 4 = 16$
$\therefore$ A's share $= \frac{9}{16}$ of £64 $=$ £36
B's share $= \frac{3}{16}$ of £64 $=$ £12
C's share $= \frac{4}{16}$ of £64 $=$ £16

(25) If £100 be distributed among 6 men, 9 women, and 12 children, what will be received by them when the shares of a man, a woman, and a child are as 3, 2, 1?

(26) The sum of two numbers is $9\frac{5}{8}$, and their difference is $4\frac{5}{8}$. Find the ratio of the numbers.

The sum of two numbers added to their difference is equal to twice the greater of the two numbers.

Hence, greater number $= (9\frac{5}{8} + 4\frac{5}{8}) \div 2$
$= (\frac{77}{8} + \frac{37}{8}) \div 2 = \frac{57}{8}$

Also, lesser number = sum of the numbers − the greater number $= 9\frac{5}{8} - \frac{57}{8} = \frac{77}{8} - \frac{57}{8} = \frac{20}{8}$

Hence, ratio of the numbers is 57 : 20.

(27) The percentage of children who are learning to write is 65 in a school of 60 children, and 78 in another school of 70; what is the percentage in the two schools together?

(28) If 24 oxen require 6 acres of turnips to supply them for 10 weeks, how many acres would supply six score of sheep for 15 weeks, on the supposition that 3 oxen eat as much as 10 sheep?

(29) A owned $\frac{4}{5}$ of a farm of 300 acres; he sold $\frac{3}{4}$ of his share to B, and B $\frac{1}{4}$ of his share to C. What is the value of C's land at £50 an acre?

(30) What number must be subtracted from the product of 9·27 and 8·003 to give the sum of 19, 27·9652, ·003, 5·0267 and 17·09?

(31) A man after paying an income tax of 7*d.* in the pound, has £248 10*s.* 8*d.* left; what was his gross annual income?

(32) A grocer mixes 13 lbs. of tea, at 3*s.* 4*d.* a pound, with 5 lbs. of tea at 4*s.* 10*d.* a lb.; at what price must he sell the mixture so as to gain $1\frac{1}{4}$*d.* on each lb.?

(33) If I lend a friend £1250 at 4 per cent. simple interest, and tell him to keep it until principal and interest amount to £1666 13*s.* 4*d.*, how long will he have it?

(34) Simplify and express the result decimally—

$$\frac{5\frac{1}{3} - \cdot042 - 2\cdot4 + 7\frac{5}{6}}{16\frac{8}{15} \div 60\frac{1}{2}}$$

(35) Divide 4 guineas between A and B, so that $\frac{1}{2}$ of A's money shall equal $\frac{2}{3}$ of B's.

$\frac{1}{2}$ of A's money $= \frac{2}{3}$ of B's

$\therefore$ the whole of " $= \frac{4}{3}$ of B's

$\therefore$ 3 times " $= 4$ times B's

$\therefore$ the money is divided in the ratio of 4 : 3, and A has the larger share.

$\therefore$ A's money : B's :: 4 : 3.

So, if the whole sum be divided into 7 parts,

A will have 4 parts, and B will have 3 parts.

$\therefore$ A's share $= \frac{4}{7}$ of 4 guineas $=$ £2 8*s.*

B's " $= \frac{3}{7}$ of " $=$ £1 16*s.*

(36) An army is besieging a town in which are 1000 men with provisions for 3 months, how many must leave at once that the rest may be able to subsist for a year?

(37) A man spends every year $\frac{3}{4}$ of his income, and invests the rest in annuities at the rate of £90 for every annuity of £3. His income is £600 to begin with, how much will it be at the end of 4 years?

(38) If I save £10 yearly and invest it in 3 per cents., and always put in the interest together with the savings for the 4 following years, what sum shall I have at the end of the time?

(39) Divide £22 9*s.* 9*d.* among three persons so that one has twice as much as the second, and three times as much as the third.

(9) £192.
(10) 94⅔.
(11) 106⅔.
(12) £550 stock; £38 10s. interest.
(13) £4577 14s. 2d.
(14) £17 3s. 9d. increase.
(15) £907 10s.
(16) The 3½ per cents.
(17) 5$\frac{5}{21}$ p. c.
(18) 82½.
(19) £11620.
(20) 80⅓.
(21) £5745 16s. 8d.
(22) £4 8s. 2$\frac{2}{17}$d.
(23) Gain, 10 p. c.
(24) £264 12s.

Exercise 7 (p. 517).

(1) 18s. 9d.
(2) 6s. 8$\frac{4}{7}$d.
(3) 22$\frac{2}{7}$ p. c.
(4) £96 9s. 8½d.
(5) £1 1s. 9d. per lb.
(6) 17 p. c.
(7) 10s.
(8) 21⅓ p. c.
(9) 3s. 9d.
(10) 28⅓ p. c.
(11) £75.
(12) 33⅓ p. c.
(13) £1 2s. 6d.
(14) Gain, 16⅔ p. c.
(15) £18$\frac{2}{3}$ p. c.
(16) 120; 42½ p. c.
(17) 9s. 7½d.
(18) 7s. 4d.; 60 p. c.
(19) £245 12s. 6d.
(20) 4$\frac{8}{13}$ p.c.; £1 2s. 1½d. loss.
(21) 14s. 8d.; 60 p. c.
(22) 8¾d.; 20$\frac{8}{11}$ p. c.
(23) 15s. hat; 11s. 5½d.
(24) £5 11s. 1½d.
(25) £13.

Exercise 8 (p. 519).

(1) 13$\frac{13}{15}$ years.
(2) 4s. 0$\frac{3}{4}$d.
(3) 50 feet.
(4) 41666$\frac{2}{3}$d.
(5) 23464·503.
(6) £340 1s. 8$\frac{1}{3}$d.
(7) 1541.
(8) 10s. 4$\frac{1}{6}$d.
(9) £640; £384; £256.
(10) Cap., £3808; £4760; £5712. Gain, £232$\frac{2}{3}$: £290$\frac{5}{6}$; £349.
(11) £27 10s.; £24 5s.; £33 5s.
(12) £19 5s.; £27 2s. 6d.; £37 12s. 6d.

(13) £321 10*s.* $10\frac{80}{180}d.$; £1157 11*s.* $0\frac{78}{180}d.$; £857 8*s.* $11\frac{7}{180}d.$; £643 1*s.* $8\frac{40}{180}d.$

(14) Son, £1644 7*s.* 6*d.*; wife, £548 2*s.* 6*d.*; daughter, £182 14*s.* 2*d.*

(15) 1122; 1734.

(16) A's, £113 16*s.* $11\frac{91}{715}d.$; B's, £59 14*s.* $0\frac{144}{715}d.$; C's, £47 1*s.* $0\frac{336}{1430}d.$

(17) 1st, £136 11*s.* $11\frac{4}{5}d.$; 2nd, £163 18*s.* $4\frac{2}{5}d.$; 3rd, £229 9*s.* $8\frac{2}{5}d.$ Each person, 1*s.* $1\frac{1}{5}d.$

(18) 5904, 1476, 492.

(19) A, £4285 14*s.* $3\frac{3}{4}d.$; B, £2857 2*s.* $10\frac{1}{2}d.$; C, £2142 17*s.* $1\frac{1}{4}d.$; D, £1714 5*s.* $8\frac{1}{4}d.$

(20) £13 12*s.* $8\frac{5}{11}d.$; £13 7*s.* $3\frac{8}{11}d.$

(21) A, £175; B, £291$\frac{2}{3}$; C, £233$\frac{1}{3}$.

(22) $10\frac{1}{8}d.$; 9*s.* $4\frac{1}{2}d.$; 3*s.* $7\frac{7}{8}d.$; 2*s.* $9\frac{3}{4}d.$

Exercise 9 (p. 523).

(1) $38\frac{2}{5}$ yards.

(2) £72 18*s.* 4*d.*

(3) $3\frac{3}{7}$ days.

(4) $7\frac{1}{6}$ oz.; 2*s.* $4\frac{2}{3}d.$

(5) 7 cwt. 1 qr. 6·92 lbs.

(6) $109\frac{1853}{1860}$; $62\frac{305}{336}$.

(7) ·03068.

(8) £13 14*s.* $5\frac{3}{80}d.$

(9) $8\frac{8}{9}$ years.

(10) 36 men.

(11) 300 men.

(12) £200.

(13) 3*s.* $1\frac{3}{16}d.$

(14) 5 for $3\frac{1}{3}d.$, or 25 for 1*s.* 6*d.*

(15) 3 days.

(16) 23464·503.

(17) 59 min. $8\frac{1470}{2849}$ sec.

(18) £946 12*s.* 6*d.*; $2\frac{3}{8}$ per cent.

(19) 134999·99755.

(20) 3 : 7

(21) 50 gals.

(22) $\cdot\dot{3}5809523\dot{}$.

(23) $\frac{9}{35}$; £3600.

(24) A, £36; B, £12; C, £16.

(25) Men, £37 10*s.*; women, £37 10*s.*; children, £25.

(26) 57 : 20.

(27) 72 per cent.

(28) $13\frac{1}{2}$ acres.

(29) £1000.

(30) 5·10291.

(31) £256.

(32) 3*s.* $10\frac{3}{4}d.$ per lb.

(33) $8\frac{1}{3}$ years.

(34) $40\frac{87}{400} = 40{\cdot}2175$.

(35) £2 8*s.*; £1 16*s.*

(36) 750.
(37) £627 2s. $3\frac{16}{36}\frac{13}{45}d.$
(38) £41 16s. 8·7048d.
(39) £12 5s. $3\frac{9}{11}d.$; £6 2s. $7\frac{10}{11}d.$; £4 1s. $9\frac{3}{11}d.$
(40) 1 cwt. 1 qr. 1 lb. 1 oz.
(41) £858.
(42) £8 3s. 4d.; £4 13s. 4d.; £2 3s. 4d.
(43) £1.
(44) £1225; £17 10s.
(45) $\frac{1}{35}$, $\frac{1}{315}$, $\frac{1}{3465}$; 7; 44·46.
(46) $8\frac{1}{3}$ per cent.
(47) £31 5s.; £41 5s.; £52 10s.; 2s. 6d. in the pound.
(48) 6s. 8d.
(49) £3 12s.
(50) $3\frac{1}{3}$ per cent.

ALGEBRA.

I. CUBE ROOT.

The cube root of a simple quantity can be found by inspection.

The cube of a is $a \times a \times a = a^3$; the cube of a^2 is $a^2 \times a^2 \times a^2 = a^6$; the cube of a^3 is a^9; and so on. Thus, generally, $(a^n)^3 = a^{3n}$. Hence the cube root of a^3 is a; the cube root of a^6 is a^2; the cube root of a^9 is a^3; and so on. Thus, generally, $\sqrt[3]{a^n} = a^{\frac{n}{3}}$. Therefore the index of the cube root is found by dividing the index of the cube quantity by 3.

Since the cube of abc is $a^3b^3c^3$, the cube root of $a^3b^3c^3$ is abc, or the product of the cube roots of the three factors a^3, b^3, c^3.

Similarly, $\sqrt[3]{x^3y^3z^3} = xyz$; $\sqrt[3]{27a^3b^3} = 3ab$; $\sqrt[3]{8x^6} = 2x^2$; $\sqrt[3]{64x^3y^9} = 4xy^3$.

Since the cube of a is a^3, the cube root of a^3 is a; that is, *the cube root of a positive quantity is positive.*

Again, since the cube of $-a$ is $-a^3$, the cube root of $-a^3$ is $-a$; that is, *the cube root of a negative quantity is negative.*

This principle may be extended thus:—

The square root of a^2 is either *plus a* or *minus a.*

The fourth root of a^4 is either *plus a* or *minus a.*

So generally, if n be even, the nth root of a^n is either positive or negative; or, $\sqrt[n]{a^n} = \pm a$.

The cube root of a^3 is *plus a*; the cube root of $-a^3$ is *minus a.*

The fifth root of a^5 is *plus a*; the fifth root of $-a^5$ is *minus a.*

So generally, if n be odd, the nth root of a^n is positive, and the nth root of $-a^n$ is negative; or, $\sqrt[n]{\pm a^n} = \pm a$.

Exercise 1.

Find the cube roots of—

(1) x^3; $8x^3$; $x^3y^3z^3$; $27m^3n^3$; $216a^3b^3$.

(2) $-x^3$; $64x^6y^3$; $-125a^3y^{12}$; $1000m^3n^9$.

(3) $64x^{15}$; $-343a^3b^6$; $1331x^{15}y^3$; $-512x^3y^3$.

(4) $-729x^{21}$; $-1728x^6y^{18}$; $27x^{27}y^9z^3$; $-8x^3y^6$.

(5) $\frac{1}{8}x^3y^9$; $-\frac{8}{27}x^6y^{15}$; $\frac{27}{64}a^{15}b^3$; $-\frac{1}{125}m^{18}$.

The method of extracting the cube root of a compound quantity is found by observing the form of the cube of $a + b$.

$$(a + b)^3 = a^3 + 3a^2b + 3ab^2 + b^3.$$

Hence the cube root of $a^3 + 3a^2b + 3ab^2 + b^3$ is $a + b$.

We have then to examine how the root $a + b$ is obtained from $a^3 + 3a^2b + 3ab^2 + b^3$.

$$\begin{array}{r|l} a^3 + 3a^2b + 3ab^2 + b^3 & a + b \\ a^3 & \\ \hline 3a^2 \quad\quad\quad & 3a^2b + 3ab^2 + b^3 \\ \quad (3a + b)\,b & \\ \hline 3a^2 + 3ab + b^2 & 3a^2b + 3ab^2 + b^3 \end{array}$$

The first term, a, of the root is obtained at once by taking the cube root of a^3, the first term of the cube quantity. Subtracting a^3 from the cube quantity, we have the remainder, $3a^2b + 3ab^2 + b^3$.

The second term, b, of the root is obtained by dividing the first term of the remainder, $3a^2b$, by $3a^2$.

The divisor is completed by adding $3ab + b^2$, or $(3a + b)b$ to $3a^2$. The whole divisor is then $3a^2 + 3ab + b^2$. This, multiplied by the second term of the root, gives the subtrahend, $3a^2b + 3ab^2 + b^3$.

The same process continued as far as necessary, will result in the extraction of the cube root when it consists of more than two terms.

The above is the general example; we will now show how it may be applied to particular quantities.

(1) Find the cube root of $8x^3 + 36x^2 + 54x + 27$.

$$\begin{array}{l|l} & 8x^3+36x^2+54x+27 \;(2x+3 \\ & 8x^3 \\ \hline 12x^2 & 36x^2+54x+27 \\ (6x+3)\,3 & \\ \hline 12x^2+18x+9 & 36x^2+54x+27 \end{array}$$

Here the terms in the whole expression are arranged according to the descending powers of x.

The first term of the root is the cube root of $8x^3$, which is $2x$. ($2x$ corresponds with a in the general example.) Subtracting the cube of $2x$ from the dividend, we have remainder $36x^2 + 54x + 27$. Three times the square of $2x$ is $12x^2$, which we set down at some distance to the left of the remainder. ($12x^2$ corresponds with $3a^2$ in the general example.)

Dividing $36x^2$ by $12x^2$, we have 3, the second term of the root. (In the general example $3a^2b \div 3a^2 = b$.)

We now complete the divisor by multiplying $2x$ by 3, adding 3 to the product, and then multiplying the sum by 3. (In the general example we had $(3a + b)b = 3ab + b^2$.)

The whole divisor then becomes $12x^2 + 18x + 9$ (which corresponds with $3a^2 + 3ab + b^2$ in the general example).

Multiplying the divisor by 3, the second term of the root, and subtracting the product from $36x^2 + 54x + 27$, we have no remainder, and the cube root, $2x + 3$, has been found.

(2) Find the cube root of $27x^3 - 54x^2y + 36xy^2 - 8y^3$.

$$\begin{array}{l|l} & 27x^3-54x^2y+36xy^2-8y^3 \;(3x-2y \\ & 27x^3 \\ \hline 27x^2 & -54x^2y+36xy^2-8y^3 \\ (9x-2y)(-2y) & \\ \hline 27x^2-18xy+4y^2 & -54x^2y+36xy^2-8y^3 \end{array}$$

Referring this process to the general example, we have; $a = 3x$; $b = -2y$; $3a^2 = 27x^2$; $3a + b = 9x - 2y$; $3a^2 + 3ab + b^2 = 27x^2 - 18xy + 4y^2$.

We will now show how the same process may be applied to the extraction of a root consisting of three terms.

(3) Find the cube root of $x^6 - 12x^5 + 57x^4 - 136x^3 + 171x^2 - 108x + 27$.

	$x^6 - 12x^5 + 57x^4 - 136x^3 + 171x^2 - 108x + 27$ $(x^2 - 4x + 3$
	x^6
$3x^4$	$-12x^5 + 57x^4 - 136x^3$
$(3x^2 - 4x)(-4x)$	
$3x^4 - 12x^5 + 16x^3$	$-12x^5 + 48x^4 - 64x^3$
$3x^4 - 24x^3 + 48x^2$	$9x^4 - 72x^3 + 171x^2 - 108x + 27$
$(3x^2 - 12x + 3)3$	
$3x^4 - 24x^3 + 57x^2 - 36x + 9$	$9x^4 - 72x^3 + 171x^2 - 108x + 27$

The first two terms of the root are obtained as before. To find the first complete divisor, we take (referring to the general example) $a = x^2$, and $b = -4x$.

After subtracting and bringing down three more terms from the dividend, the process is continued thus, for the purpose of finding the third term :—

The quotient is now $x^2 - 4x$; this is represented by a in the general example; hence, $3a^2 = 3(x^2 - 4x)^2 = 3x^4 - 24x^3 + 48x^2$, which is placed to the left as before. Dividing $9x^4$ by $3x^4$, we have the third term, 3, which is represented by b in the general example; hence, $(3a + b)b = \{3(x^2 - 4x) + 3\}3 = (3x^2 - 12x + 3)3$. By adding the two lines as before, the second complete divisor is found to be $3x^4 - 24x^3 + 57x^2 - 36x + 9$. Multiplying this by the third term, 3, and subtracting the product, we find that there is no remainder. The cube root is $x^2 - 4x + 3$.

The expression $3x^4 - 24x^3 + 48x^2$ may be found more easily thus :—add the two expressions just above, namely, $3x^4 - 12x^3 + 16x^2$ and $(3x^2 - 4x)(-4x)$ to $(-4x)^2$. The result is $3x^4 - 24x^3 + 48x^2$. The two expressions are represented by $(3a + b)b$ and $3a^2 + 3ab + b^2$ (see general example), which, added together, are equal to $3a^2 + 6ab + 2b^2$. If b^2 be also added, the sum is $3a^2 + 6ab + 3b^2$, and this is the general expression of which the quantity $3x^4 - 24x^3 + 48x^2$ is a particular

example. For, in Example 3; $a = x^2$, and $b = -4x$. Hence $3a^2 + 6ab + 3b^2 = 3x^4 - 24x^3 + 48x^2$.

Exercise 2.

Find the cube roots of—

(1) $x^3 + 3x^2 + 3x + 1$.
(2) $8a^3 + 36a^2b + 54ab^2 + 27b^3$.
(3) $8m^3 - 36m^2 + 54m - 27$.
(4) $1 - 3x + 3x^2 - x^3$.
(5) $125x^3 - 300x^2y + 240xy^2 - 64y^3$.
(6) $27x^6 - 81x^4 + 81x^2 - 27$.
(7) $343x^3 - 1323x^2y + 1701xy^2 - 729y^3$.
(8) $x^6 - 12x^5 + 54x^4 - 112x^3 + 108x^2 - 48x + 8$.
(9) $x^6 - 9x^5 + 30x^4 - 45x^3 + 30x^2 - 9x + 1$.
(10) $m^6 - 6m^5 + 15m^4 - 20m^3 + 15m^2 - 6m + 1$.
(11) $x^6 - 6x^5 + 40x^3 - 96x - 64$.
(12) $a^6 + 3a^5 + 6a^4 + 7a^3 + 6a^2 + 3a + 1$.
(13) $a^9 + 6a^8 + 12a^7 + 5a^6 - 12a^5 - 12a^4 + 3a^3 + 6a^2 - 1$.

II. SIMULTANEOUS EQUATIONS.

When it is required to find two unknown quantities, x and y, *two* equations are necessary in order that a definite solution may be arrived at. For if we had only one equation involving x and y, an infinite number of values might be found which could be substituted for x and y. Thus the equation—

$$5x - 4y = 3$$

may be satisfied by taking $x = 1$ and $y = \frac{1}{2}$, or by taking $x = 2$ and $y = 1\frac{3}{4}$, or by taking $x = 3$ and $y = 3$, or by taking $x = 4$ and $y = 4\frac{1}{4}$, and so on to an infinite number of values of x and y,

If, however, we have two distinct equations involving two unknown quantities, x and y, these equations can only be satisfied by certain definite values of x and y.

In like manner, in order that definite values may be found for *three* unknown quantities, x, y, and z, it is necessary that *three*

equations should be given, and so on to any larger number of unknown quantities.

The present chapter relates to the solution of equations involving *two* unknown quantities, x and y.

There are three methods which may be employed in the solution of equations of this kind. These will be illustrated in the following example, which we shall work by each method.

(1) $$\left.\begin{aligned} 3x + 4y &= 18 \\ 8x - 5y &= 1 \end{aligned}\right\}$$

FIRST METHOD.—Multiply the equations by such numbers as will make the co-efficients of x equal.

Thus, if we multiply the first equation by 8, and the second equation by 3, the two equations will stand thus :—

$$24x + 32y = 144$$
$$24x - 15y = 3$$

By *subtracting* the second of these equations from the first, we make x disappear. Thus, we have—

$$47y = 141$$
$$\therefore y = 3$$

Having found the value of y, we can easily find that of x.

For $3x + 4y = 18$

Substitute for y the value we have just found. Then—

$$3x + 12 = 18$$
$$\therefore 3x = 18 - 12 = 6$$
$$\therefore x = 2$$

Thus, $x = 2$, and $y = 3$.

The same method might have been employed thus :—

Multiply the two equations by such numbers as will make the coefficients of y equal.

Thus, if we multiply the first equation by 5, and the second equation by 4, the two equations will stand thus :—

$$15x + 20y = 90$$
$$32x - 20y = 4$$

By *adding* these two equations together, we make y disappear. Thus we have—

$$47x = 94$$
$$\therefore\ x = 2$$

And $3x + 4y = 18$

Substitute for x the value which we have just found. Then—

$$6 + 4y = 18$$
$$\therefore\ 4y = 12$$
$$\therefore\ y = 3$$

Thus, after making the coefficients of one of the two unknown quantities equal in both equations, we *eliminate* (or cause to disappear) that unknown quantity by means of addition or subtraction. The value of one unknown quantity is then easily found. The value of the other unknown quantity is found by substituting the value already obtained in one of the original equations.

If the coefficients of either of the two unknown quantities are already equal in the two original equations, it will, of course, be unnecessary to multiply them. Thus, if we have these equations given—

(2) $$\left.\begin{aligned} 3x - y &= 9 \\ 4x + y &= 12 \end{aligned}\right\}$$

we observe that the coefficients of y are equal in the two equations, and that y can be eliminated by simply adding them together.

Sometimes it is only necessary to multiply *one* of the equations.

(3) $$\left.\begin{aligned} 8x + 3y &= 27 \\ 2x - 7y &= 1 \end{aligned}\right\}$$

Here we can equalize the coefficients of x by simply multiplying the *second* equation by 4.

SECOND METHOD. $$\left.\begin{aligned} 3x + 4y &= 18 \\ 8x - 5y &= 1 \end{aligned}\right\}$$

Find an expression for y in the *first* equation.

$$\text{Thus, } 4y = 18 - 3x$$
$$\therefore y = \tfrac{1}{4}(18 - 3x)$$

Find an expression for y in the *second* equation.

$$\text{Thus, } 5y = 8x - 1$$
$$\therefore y = \tfrac{1}{5}(8x - 1)$$

We have now obtained two expressions for y. These are of course equal.

Equating these two expressions for y, we have—

$$\tfrac{1}{4}(18 - 3x) = \tfrac{1}{5}(8x - 1)$$

We now have a simple equation with only one unknown quantity, x.

$$5(18 - 3x) = 4(8x - 1)$$
$$\therefore 90 - 15x = 32x - 4$$
$$\therefore 47x = 94$$
$$\therefore x = 2.$$

Substituting this value of x in the first equation, we have, as before—

$$6 + 4y = 18$$
$$\therefore 4y = 12$$
$$\therefore y = 3$$

This example might also have been solved by equating the values of x found from the two equations in a similar manner. In this case the value of y would have been found first.

THIRD METHOD.

$$\left.\begin{aligned} 3x + 4y &= 18 \\ 8x - 5y &= 1 \end{aligned}\right\}$$

Find an expression for y in the first equation, as before.

$$\text{Thus, } 4y = 18 - 3x$$
$$\therefore y = \tfrac{1}{4}(18 - 3x)$$

Substitute this expression for y in the second equation; then we have—

$$8x - 5\{\tfrac{1}{4}(18 - 3x)\} = 1.$$

This is a simple equation with only one unknown quantity, x.

$$8x - \tfrac{5}{4}(18 - 3x) = 1$$
$$\therefore 32x - 90 + 15x = 4$$
$$\therefore 47x = 94$$
$$\therefore x = 2$$

We can now find y from the first equation, as before.

$$6 + 4y = 18$$
$$\therefore 4y = 12$$
$$\therefore y = 3$$

It is impossible to lay down fixed rules as to which method should be employed in any particular example. The student should at first accustom himself to work out each example by each method.

We have here given the equations in their simplest forms. It will often be necessary to reduce them to these forms before proceeding further.

(4)
$$\left.\begin{aligned} \tfrac{x}{2} + \tfrac{2}{y} &= \tfrac{5}{4} \\ \tfrac{x}{3} + \tfrac{3}{y} &= \tfrac{5}{3} \end{aligned}\right\}$$

From the first equation we have—

$$2xy + 8 = 5y.$$

From the second equation, we have—

$$xy + 9 = 5y.$$

Multiply the second of these equations by 2,

$$2xy + 18 = 10y$$
Also $2xy + 8 = 5y$
Subtracting, $10 = 5y$
$$\therefore y = 2.$$
But $xy + 9 = 5y$
$\therefore$ (substituting 2 for y) $2x + 9 = 10$
$$\therefore 2x = 1$$
$$\therefore x = \tfrac{1}{2}.$$

Exercise 3.

(These examples are mostly taken from Government Examination Papers.)

(1) $\left.\begin{aligned} 7x+y &= 71 \\ 8x+2y &= 112 \end{aligned}\right\}$

(2) $\left.\begin{aligned} 4x-3y &= 2 \\ 5x-2y &= 9\tfrac{1}{2} \end{aligned}\right\}$

(3) $\left.\begin{aligned} 2x-y &= 10 \\ 5x+2y &= 63 \end{aligned}\right\}$

(4) $2x+3y = 5 = -2(2y+3x)$

Note.—The two equations are—

$$2x+3y=5, \text{ and}$$
$$-2(2y+3x)=5$$

(5) $\left.\begin{aligned} 4x-y &= 7 \\ 3x+4y &= 29 \end{aligned}\right\}$

(6) $7x-3y = 3x+y = 36$

(7) $\left.\begin{aligned} 13x &= 9y+94 \\ 11y+19x &= 548 \end{aligned}\right\}$

(8) $\left.\begin{aligned} 7x+10y &= 149 \\ 11x-14y+119 &= 0 \end{aligned}\right\}$

(9) $\left.\begin{aligned} 85x-90y &= 155 \\ 18x-19y &= 33 \end{aligned}\right\}$

(10) $\left.\begin{aligned} 11x+7y &= 314 \\ 15x-19y &= 0 \end{aligned}\right\}$

(11) $\left.\begin{aligned} 10x-9y &= 22 \\ 13x-19y &= 0 \end{aligned}\right\}$

(12) $3x-5y = x+9y+14 = 166$

(13) $\left.\begin{aligned} xy-x &= 70 \\ xy+x &= 84 \end{aligned}\right\}$

(14) $2x-5y = 2 = 8y-3x+3$

(15) $\left.\begin{aligned} x+y &= c \\ ax &= by \end{aligned}\right\}$

Here, $y = c - x$

(substituting this value of y in the second equation)

$$ax = b(c - x)$$
$$= bc - bx$$
$$\therefore ax + bx = bc$$
$$\therefore x = \frac{bc}{a+b}$$
$$y = c - x = c - \frac{bc}{a+b} = \frac{ac + bc - bc}{a+b}$$
$$= \frac{ac}{a+b}$$

(16) $\left.\begin{aligned} x + y &= m \\ ax + y &= n \end{aligned}\right\}$

(17) $\left.\begin{aligned} 2x - \frac{y-3}{5} & \\ 3y + \frac{x-2}{3} &= 9 \end{aligned}\right\}$

(18) $\left.\begin{aligned} \frac{3x}{5} - \frac{5y}{3} + \frac{38}{15} &= 0 \\ 5x - 3y &= 25 \end{aligned}\right\}$

(19) $\left.\begin{aligned} \frac{x}{3} + \frac{y}{4} &= 6 \\ 1 - \frac{x-y}{4} &= 7 \end{aligned}\right\}$

(20) $\left.\begin{aligned} \frac{x+y}{2} &= a \\ \frac{x-y}{2} &= b \end{aligned}\right\}$

(21) $\left.\begin{aligned} \frac{5x+y}{40} &= \frac{y}{4} - x \\ \frac{2x-y}{6} &= 2x - \frac{1}{2} \end{aligned}\right\}$

(22) $\frac{7x}{2} + \frac{y+2}{5} = 8 = 3y - \frac{1}{4}(x+2)$

(23) $\left.\begin{aligned} \frac{3x-7y}{3} &= \frac{2x+y+1}{5} \\ 8 &- \frac{x-y}{5} = 6 \end{aligned}\right\}$

(24) $\left.\begin{aligned} \frac{x}{2} - 12 &= \frac{y}{4} + 8 \\ \frac{x+y}{5} + \frac{x}{3} &= \tfrac{1}{8}(2y-x) + 35 \end{aligned}\right\}$

(25) $\left.\begin{aligned} 2x + \cdot 4y &= 1\cdot 2 \\ 3\cdot 4x - \cdot 02y &= \cdot 01 \end{aligned}\right\}$

(26) $\left.\begin{aligned} \frac{a}{x} + \frac{b}{y} &= 1 \\ \frac{b}{x} - \frac{a}{y} &= 1 \end{aligned}\right\}$

(27) $2x - 3y + 2 = 7x - 8y - 3 = 0$

(28) $\frac{5x}{6} - \frac{3y}{7} = 2 = \frac{x}{2} - \frac{y}{7}$

Various **problems**, which require two or more **unknown** quantities to be found, can be solved by means of **simultaneous** equations. The following are examples of problems producing simultaneous equations of two unknowns.

(1) There are two numbers; if 3 be taken from each, then the second is five times as great as the first; but if 2 be taken from each, then the second is only three times as great as the first. Find the numbers.

Let x = the first number,
and y = the second number.

Then, $x - 3 = \frac{1}{5}(y - 3)$
$\therefore 5x - 15 = y - 3$
$\therefore 5x - y = 12 \quad . \quad . \quad . \quad (1)$
Again, $x - 2 = \frac{1}{3}(y - 2)$
$\therefore 3x - 6 = y - 2$
$\therefore 3x - y = 4 \quad . \quad . \quad . \quad (2)$

We now have two equations from which to find x and y.

Subtracting (2) from (1), we have—

$$2x = 8$$

$$\therefore \quad x = 4$$

Substituting this value of x in (1), we have—

$$20 - y = 12$$

$$\therefore y = 20 - 12 = 8$$

Thus, the two numbers are 4 and 8.

(2) A bill of £23 15*s.* was paid in half-crowns and sovereigns, so that three times the number of sovereigns was just equal to twice the number of half-crowns. Find the number of each kind of coins.

Let x = the number of half-crowns,

and y = the number of sovereigns,

$\therefore$ $2\frac{1}{2}x$ = the value of the half-crowns in shillings,

and $20y$ = the value of the sovereigns in shillings.

But the whole sum paid was £23 15*s.*, or 475 shillings,

$$\therefore \quad 2\tfrac{1}{2}x + 20y = 475$$

$$\therefore \quad 5x + 40y = 950 \quad . \quad . \quad . \quad . \quad (1)$$

$$\text{Again, } 3y = 2x \quad . \quad . \quad . \quad . \quad (2)$$

$$\therefore \quad y = \tfrac{2}{3}x$$

Substituting this value of y in (1), we have—

$$5x + \tfrac{80}{3}x = 950$$

$$\therefore \quad 15x + 80x = 2850$$

$$\therefore \quad 95x = 2850$$

$$\therefore \quad x = 30$$

Substituting this value of x in (2), we have—

$$3y = 60$$

$$\therefore \quad y = 20$$

Thus, there were 30 half-crowns and 20 sovereigns.

(3) A and B engage in play; in the first game A loses one-third of what he had, and finds that he then has 1*s.* less than half as much as B; in the second game A gains six shillings, and then they each have the same amount left. Find how much each had at first.

Let x = number of shillings A had at first,
and y = number of shillings B had at first.

Then, at the end of the first game,

A has $x - \frac{1}{3}x$, and B had $y + \frac{1}{3}x$

$\therefore x - \frac{1}{3}x = \frac{1}{3}(y + \frac{1}{3}x) - 1$

$\therefore x - \frac{1}{3}x = \frac{1}{3}y + \frac{1}{9}x - 1$

$\therefore 6x - 2x = 3y + x - 6$

$\therefore 3x - 3y = -6$

$\therefore 3y - 3x = 6$

$\therefore y - x = 2 \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$

Again, at the end of the second game,

A has $x - \frac{1}{3}x + 6$, and B has $y + \frac{1}{3}x - 6$

$\therefore x - \frac{1}{3}x + 6 = y + \frac{1}{3}x - 6$

$\therefore 3x - x + 18 = 3y + x - 18$

$\therefore x - 3y = -36 \quad . \quad . \quad . \quad . \quad (2)$

Adding (1) and (2), we have

$-2y = -34$

$\therefore y = 17$

Substituting this value of y in (1), we have

$17 - x = 2$

$\therefore x = 17 - 2 = 15$

Thus A had 15*s.* and B had 17*s.* at first.

Exercise 4.

(1) There are two numbers; if one-fifth of the second be taken from it and added to the first, they will be equal; but if one-third of the first be taken from it and added to the second, then the second will be three times as great as the first. Find the original numbers.

(2) There are three numbers whose sum is 16. The third is one less than three times the first, and the second is equal to the difference between the first and third. Find the three numbers.

Note.—If x be taken for the first number, and y for the second, then the third will be $16 - x - y$.

This problem could also be solved by means of an equation

of *one* unknown quantity only. The pupil should solve it both ways.

(3) A father said: Five years ago my age was nine times as great as that of my son; but ten years hence it will only be three times as great. Find the present ages of the father and son.

(4) There is a certain fraction; if 2 be taken from the numerator the value becomes $\frac{1}{2}$; but if nine be added to the denominator the value becomes $\frac{1}{3}$. Find the fraction.

(5) Three sheep and four cows cost £20 10*s.*; five sheep and two cows cost £15 10*s.* Find the cost price of each sheep and of each cow.

(6) There are two kinds of coin. Twelve of the first together with eight of the second are worth £2 6*s.*, and five of the first together with ten of the second are worth £1 12*s.* 6*d.* Find the value of each kind of coin.

(7) A farmer sold, at one time, 30 bushels of wheat and 40 of barley, and for the whole received £13 10*s.*; and at another time he sold 50 bushels of wheat and 30 of barley at the same prices as before, and for the whole received £17. It is required to find the price per bushel at which each sort of grain was sold.

(8) The sum of the digits of a certain number is equal to one-fourth of the number itself. If the order of the digits be reversed, the sum of the digits is equal to one-seventh of the number thus obtained. Find the original number.

Let x be the first digit (to the left hand)
and y be the second digit.
Then, $10x$ = value of the first digit (tens)
and y = value of the second digit (units).
$\therefore 10x + y$ = the number,
Also $x + y$ = sum of the digits,
$\therefore 10x + y = 4(x + y)$ . . . (1)
Again, if the order of the digits be reversed,
Then, $10y + x$ = the number thus obtained,
$\therefore 10y + x = 7(x + y)$ . . . (2)
From these two equations the values of x and y can be found.

(9) The sum of the heights of two towers is five times their difference, and half the height of the higher tower is four feet less than four-fifths of the height of the lower tower. Find the heights of the two towers.

(The following examples are taken from previous Government Examination Papers.)

(10) What fraction is that which becomes $\frac{1}{2}$ or $\frac{1}{3}$ according as its numerator and denominator are both increased by 2 or both diminished by 2?

(11) A certain number consists of two digits; the sum of the digits is 6; and if the number be increased by 18 the digits will be inverted.

(12) £24 are to be given to the best shots in a volunteer corps; some wished each long-range man to receive £2, and each short-range man £1 10*s.*, whilst others thought the best division would be to give £1 15*s.*, to each of the former and £1 13*s.* 9*d.* to each of the latter. How many prize men were there?

(13) The united ages of a man and his wife are six times the united ages of their children. Two years ago their united ages were ten times the united ages of their children, and six years hence their united ages will be three times the united ages of the children. How many children have they?

Let x = united ages of parents at present; and y = number of children.

Then $\frac{x}{6}$ = united ages of children at present; and $\frac{y}{6y}$ = average age of children at present.

United age of parents two years ago $= x-4$; and united age of children two years ago $= \frac{x}{6} - 2y$,

$$\therefore\ x-4 = \left(\frac{x}{6} - 2y\right)10$$

$$= \left(\frac{x-12y}{6}\right)10$$

$$\therefore\ 6x - 24 = 10x - 120y$$

$$\therefore\ 4x = 120y - 24$$

$$\therefore\ x = 30y - 6 \quad \ldots\ldots \quad (1).$$

United age of parents six years hence $= x + 12$; and united age of children six years hence $= \frac{x}{6} + 6y$,

$$\therefore x + 12 = \left(\frac{x}{6} + 6y\right)3$$
$$= \left(\frac{x + 36y}{6}\right)3$$
$$\therefore 2x + 24 = x + 36y$$
$$\therefore x = 36y - 24 \quad \ldots\ldots \quad (2)$$
$$\therefore 30y - 6 = 36y - 24$$
$$\therefore 6y = 18$$
$$\therefore y = 3 = \text{the number of children.}$$

(14) A certain number of two digits contains the sum of its digits 4 times, and their product 6 times. What is the number?

(15) Find three numbers such that the product of the first and the sum of the other two shall be 152, the product of the second and the sum of the other two 162, and the product of the third and the sum of the other two 170.

(16) Two trains, A and B, are despatched from opposite termini of a railway at the same time, with speeds of 20 and 30 miles per hour respectively; a third train, C, is despatched after B three hours later, with a speed of 40 miles per hour; what is the length of the railway if A pass C half an hour after passing B?

Let x = length of railway in miles, and y = number of hours A and B run before they meet.

(17) Two trucks whose wheels are of different sizes are in motion; one makes 2,002 revolutions more than the other in 7 miles, whereas if the wheels had been twice as large in circumference, it would have made 770 less than the other; find the circumference of the wheels.

(18) A and B walk over the same ground, going out one way and coming home the other, but they start in opposite directions. A walks $3\frac{3}{4}$ miles per hour, and B walks 4 miles per

hour. A wants a quarter of a mile of being half way when he meets B. Required the length of the walk.

(19) A person was asked £50 for a quantity of books; he obtained them, however, at a discount of 3*d.* in the shilling for the new ones, and 1*d.* in the shilling for the old ones. He found he gave £4 3*s.* 4*d.* more for the new ones than the old. What was the price given for the new and old respectively?

(20) A farmer has a number of hurdles, 6 feet long. He finds that by arranging them so as to enclose a given space of ground, if he place them 1 foot distant from each other, he has not enough by 80; but if he place them a yard apart, he has 50 hurdles to spare. How many hurdles has he?

Let x = number of hurdles; and y = no. of feet they are to extend.

(21) The ages of two men are now as 4 to 3, but 9 years ago they were as 3 to 2: find their present ages.

III. QUADRATIC EQUATIONS.

A Quadratic Equation is one whose terms involve the *square* of the unknown quantity, but contain no higher power of it.

A **Pure Quadratic Equation** is one which contains the second power only of the unknown quantity.

An **Adfected Quadratic Equation** is one which contains both the first and second powers of the unknown quantity.

Thus, $x^2 = 25$ is a pure quadratic equation, because it contains only the second power of x; but $x^2 + 5x = 28$ is an adfected quadratic equation, because it contains both the first and second powers of x.

A Quadratic equation is sometimes called an equation of the *second degree*, because the *second* is the highest power of the unknown quantity which it contains.

In like manner, a simple equation, which contains only the first power of the unknown quantity, is called an equation of the *first degree*.

Similarly an equation in which the cube of the unknown quantity is the highest power of that unknown quantity is called an equation of the *third degree:* and so on to equations of the *fourth, fifth,* and any higher degrees.

(*a*) Pure Quadratic Equations.

These are solved with little difficulty.

(1) $x^2 = 25$

Take the square root of both sides,

Then $x = \sqrt{25} = \pm 5$.

Here we have two solutions, since the square root of 25 may be either *plus* 5 or *minus* 5. Similarly it will be found that all quadratic equations admit of two solutions. In other words, two values of the unknown quantity may be found.

(2) $3x^2 - 15 = 0$

$\therefore 3x^2 = 15$

$\therefore x^2 = 5$

$\therefore x = \pm \sqrt{5}$.

Here we cannot find the exact square root of 5. In a case of this kind we can simply write the quantity as a *surd* with the radix before it, or we can extract the square root to any number of decimal places required.

Thus $x = 2{\cdot}23606$ or $-2{\cdot}23606$

(3) $ax^2 = 3ab - 4x^2$

$\therefore ax^2 + 4x^2 = 3ab$

$\therefore x^2(a + 4) = 3ab$

$$\therefore x^2 = \frac{3ab}{a+4}$$

$$\therefore x = \pm \sqrt{\frac{3ab}{a+4}}$$

From these examples we see that a pure quadratic equation is solved by first finding the value of x^2 according to the method employed in simple equations, and then extracting the square root of that value.

Exercise 5.

(1) $x^2 = 64$. (2) $5x^2 = 45$.

(3) $2x^2 = 12 - x^2$. (4) $3x^2 - 1 = 4 - 2x^2$.

(5) $x^2 - 90 = 8 - x^2$. (6) $2x^2 = 6 - x^2$.

(7) $x^2 - 24 = 1\frac{3}{5} - \frac{3}{5}x^2$. (8) $3x^2 = 30 - \frac{1}{3}x^2$.

(9) $\frac{5}{8}x^2 - 1\frac{1}{4} = 3\frac{1}{2} - \frac{7}{8}x^2$. (10) $\frac{1}{3}x^2 - \frac{1}{4}a - \frac{3}{8}b = \frac{1}{8}a + \frac{1}{16}x^2$.

(11) $x - 3 = \dfrac{22 - 7x}{x - 4}$.

(12) $\dfrac{x - c}{b + c} = \dfrac{2bc}{(x - b)(b + c)} - \dfrac{x}{x - b}$.

(*b*) Adfected Quadratic Equations.

An adfected quadratic equation containing only one unknown quantity can always be reduced to the form $x^2 + px + q = 0$. Here the coefficient of x^2 is 1 (or unity), the coefficient of x is p, and q is a term which does not involve the unknown quantity. The letters p and q are used to represent the known quantities which appear in any particular equation. Thus, if the equation be $x^2 + 3x + 5 = 0$; then $p = 3$ and $q = 5$. Then, since—

$$x^2 + px + q = 0$$

$$\therefore \quad x^2 + px = -q.$$

Add the square of half the coefficient of x to each side.

$$\therefore x^2 + px + \tfrac{1}{4}p^2 = \tfrac{1}{4}p^2 - q$$

Now the left-hand side of this equation is the square of $x + \frac{1}{2}p$.

For in the formula $(a + b)^2 = a^2 + 2ab + b^2$, if we make $a = x$ and $b = \frac{1}{2}p$, we have $(x + \frac{1}{2}p)^2 = x^2 + (2 \times \frac{1}{2}p \times x) + (\frac{1}{2}p)^2 = x^2 + px + \frac{1}{4}p^2$.

$$\therefore (x + \tfrac{1}{2}p)^2 = \tfrac{1}{4}p^2 - q$$

Take the square root of both sides of this equation.

$$\therefore x + \tfrac{1}{2}p = \pm\sqrt{\tfrac{1}{4}p^2 - q}$$

$$\therefore x = -\tfrac{1}{2}p \pm \sqrt{\tfrac{1}{4}p^2 - q}$$

Here we have found the values of x in terms of p and q, which are known quantities.

There are two values of x, according as we take the upper or lower sign standing before the radix.

It should be observed that p and q may represent any known quantities, either positive or negative. For example, if the equation be $x^2 - 3x - 5 = 0$; then we have $p = +(-3)$ and $q = +(-5)$, and hence $-p = 3$ and $-q = 5$.

The young student will understand the equation in its general form better when he has worked through the particular examples given below.

(1) $$x^2 + 4x - 12 = 0$$

The coefficient of x^2 is unity, and the equation is in the form indicated by the general equation.

Transpose the term which does not contain x to the right-hand side of the equation; then we have—

$$x^2 + 4x = 12$$

Now add the square of half the coefficient of x to each side of the equation. The coefficient of x is 4; the half of 4 is 2; the square of 2 is 4. Adding 4 to each side, we have—

$$\begin{aligned} x^2 + 4x + 4 &= 12 + 4 \\ &= 16 \end{aligned}$$

The left-hand side of this equation is now a perfect square, being the square of $x + 2$.

$$\therefore (x + 2)^2 = 16$$

Take the square root of both sides—

$$\therefore x + 2 = \pm 4$$

We now have a simple equation.

$$\begin{aligned} \text{Transposing, } x &= \pm 4 - 2 \\ &= 2, \text{ or } -6 \end{aligned}$$

The first value is obtained by taking the *plus* sign; the second value by taking the *minus* sign.

(2) $x^2 - 8x + 15 = 0$

$\therefore \quad x^2 - 8x = -15$

Half the coefficient of x is 4.

Add the square of 4 to each side.

$\therefore x^2 - 8x + 16 = 1$

that is, $(x-4)^2 = 1$

Take the square root of both sides.

$\therefore x - 4 = \pm 1$

$\therefore x = \pm 1 + 4$

$= 5$, or 3

(3) $x^2 - 4x = 12$

Add the square of 2 to each side.

$\therefore x^2 - 4x + 4 = 16$

Take the square root of both sides.

$\therefore x - 2 = \pm 4$

$\therefore x = \pm 4 + 2$

$= 6$, or -2

(4) $x^2 - 3x = 10$

Half the coefficient of x is $\frac{3}{2}$.

Add the square of $\frac{3}{2}$ to each side.

$\therefore x^2 - 3x + (\frac{3}{2})^2 = 10 + \frac{9}{4} = \frac{49}{4}$

Take the square root of both sides.

$\therefore x - \frac{3}{2} = \pm \frac{7}{2}$

$\therefore x = \pm \frac{7}{2} + \frac{3}{2}$

$= 5$, or -2

Exercise 6.

(1) $x^2 - 4x + 3 = 0$

(2) $x^2 - 6x = 16$

(3) $x^2 + 8x = 33$

(4) $x^2 + x = 6$

(5) $x^2 - 10x = -24$

(6) $x^2 - 8x + 15 = 0$

(7) $x^2 - 6x = 16$

(8) $x^2 + 4x = 5$

(9) $x^2 - 3x = 28$

(10) $x^2 - 5x = 14$

(11) $x^2 + 7x = 8$

(12) $x^2 - 9x = 22$

(1) $$2x^2 - 7x = 15$$

Here the coefficient of x^2 is not *unity*, but 2.

Hence, in order to bring the equation into the proper form, it is necessary to divide both sides by 2. Then we have—

$$x^2 - \tfrac{7}{2}x = \tfrac{15}{2}$$

Half the coefficient of x is $\frac{7}{4}$

Add the square of $\frac{7}{4}$ to each side.

$$\therefore x^2 - \tfrac{7}{2}x + (\tfrac{7}{4})^2 = \tfrac{15}{2} + \tfrac{49}{16} = \tfrac{169}{16}$$

Take the square root of both sides.

$$\therefore x - \tfrac{7}{4} = \pm \tfrac{13}{4} + \tfrac{7}{4}$$

$$\therefore x = 5, \text{ or } -1\tfrac{1}{2}$$

(2) $$3x^2 + 40x + 1 = 2x - 2x^2 - 20$$

By transposing

$$5x^2 + 38x = -21$$

Divide both sides by 5, the coefficient of x^2

$$\therefore x^2 + \tfrac{38}{5}x = -\tfrac{21}{5}$$

Add the square of $\frac{19}{5}$ to both sides.

$$\therefore x^2 + \tfrac{38}{5}x + (\tfrac{19}{5})^2 = -\tfrac{21}{5} + \tfrac{361}{25} = \tfrac{256}{25}$$

Take the square root of both sides.

$$\therefore x + \tfrac{19}{5} = \pm \tfrac{16}{5}$$

$$\therefore x = \pm \tfrac{16}{5} - \tfrac{19}{5}$$

$$= -\tfrac{3}{5}, \text{ or } -7$$

(3) $$\frac{7x}{3} + \frac{3-x}{2x} = 20\tfrac{5}{6}$$

It is first necessary, as in simple equations, to clear both sides of fractions. The L.C M of the denominators is $6x$.

$$\therefore 14x^2 + 9 - 3x = 124x$$

$$\therefore 14x^2 - 127x = -9$$

$$\therefore x^2 - \tfrac{127}{14}x = -\tfrac{9}{14}$$

Add $(\frac{127}{28})^2$ to both sides.

$$\therefore x^2 - \tfrac{127}{14}x + (\tfrac{127}{28})^2 = -\tfrac{9}{14} + \tfrac{16129}{784}$$

$$= \tfrac{15625}{784}$$

$$\therefore x - \tfrac{127}{28} = \pm \tfrac{125}{28}$$

$$\therefore x = \pm \tfrac{125}{28} + \tfrac{127}{28}$$

$$= 9, \text{ or } \tfrac{1}{14}$$

(4) $2nx - mn = 4x^2 - 2mx$

$\therefore 4x^2 - 2mx - 2nx = -mn$

$\therefore x^2 - \frac{1}{2}(m+n)x = -\frac{1}{4}mn$

Half the co-efficient of x is $\frac{1}{4}(m+n)$

Add $\{\frac{1}{4}(m+n)\}^2$ to both sides.

$\therefore x^2 - \frac{1}{2}(m+n)x + \{\frac{1}{4}(m+n)\}^2 = -\frac{1}{4}mn + \frac{1}{16}(m+n)^2$

$= -\frac{1}{4}mn + \frac{1}{16}m^2 + \frac{1}{8}mn + \frac{1}{16}n^2$

$= \frac{1}{16}m^2 - \frac{1}{8}mn + \frac{1}{16}n^2$

$= (\frac{1}{4}m - \frac{1}{4}n)^2$

Take the square root of both sides

$\therefore x - \frac{1}{4}(m+n) = \pm(\frac{1}{4}m - \frac{1}{4}n)$

$\therefore x = \pm(\frac{1}{4}m - \frac{1}{4}n) + \frac{1}{4}(m+n)$

$= \frac{1}{2}m$, or $\frac{1}{2}n$

(5) $\frac{2x}{x-4} + \frac{x-5}{x-3} + 1 = 0$

$\therefore 2x(x-3) + (x-4)(2x-5) + (x-4)(x-3) = 0$

$\therefore 2x^2 - 6x + 2x^2 - 13x + 20 + x^2 - 7x + 12 = 0$

$\therefore 5x^2 - 26x = -32$

$\therefore x^2 - \frac{26}{5}x = -\frac{32}{5}$

$\therefore x^2 - \frac{26}{5}x + (\frac{13}{5})^2 = -\frac{32}{5} + \frac{169}{25}$

$= \frac{9}{25}$

$\therefore x - \frac{13}{5} = \pm\frac{3}{5}$

$\therefore x = \pm\frac{3}{5} + \frac{13}{5}$

$= 3\frac{1}{5}$, or 2

Exercise 7.

(1) $4x^2 - 15x + 9 = 0$.

(2) $2x^2 + x = 1$.

(3) $3x^2 + 6x = 24$.

(4) $5x^2 - 32 = 30x + 3$.

(5) $2x^2 - 16x + 37 = 7$.

(The following are selected from previous Government Examination Papers.)

(6) $3x^2 + 5x = 28$.

(7) $35x^2 + 31x + 6 = 0$.

(8) $17x^2 - 19x - 1848 = 0$.

(9) $19x^2 - 4x = 288$.

(10) $125x^2 + 27x = 9\frac{1}{5}$.

(11) $x + 1 = 182x^2$.

(12) $2x^2 + ax = a^2$.

(13) $57x^2 - 1938 = 19x$.

(14) $32x^2 - 3 = 20x$.

(15) $3x^2 + 5ax - 2a^2 = 0$.

(16) $(x - 2)(x + 3) = 36$.

(17) $(x + 1)(2x + 3) = 4x^2 - 22$.

(18) $11x^2 + 1 = 4(2 - x)^2$.

(19) $x^2 + (x + 5)^2 = 1525$.

(20) $x^2 - (a + b)x + ab = 0$.

(21) $\frac{x+1}{7} + \frac{8}{x-2} = 3$.

(22) $x = 1\frac{2}{5} + \frac{x^2}{12}$.

(23) $\frac{1}{x-3} + \frac{1}{x-5} = \frac{4}{5}$.

(24) $x + \frac{1}{x} - 1\frac{3}{5} = 0$.

(25) $\frac{x}{2} + \frac{x-4}{x+4} = \frac{x}{3}$.

(26) $x - \frac{14}{x} - 5 = 0$.

(27) $\frac{1}{x+a+b} = \frac{1}{x} + \frac{1}{a} + \frac{1}{b}$.

(28) $\frac{x+22}{3} - \frac{4}{x} = \frac{9x-6}{2}$.

(29) $\frac{8-x}{2} - \frac{2x-11}{x-3} = \frac{x-2}{6}$.

(30) $\frac{3x+8}{x-4} - \frac{5(12-x)}{2x+3} = 11$.

(31) $\frac{13}{2+x} + \frac{4}{x} - 3\frac{14}{15} = 0$.

(32) $\frac{x+2}{x-2} + \frac{x-2}{x+2} = 1\frac{3}{4}$.

(33) $\frac{3x}{x+2} - \frac{x-1}{6} = x-9$.

(34) $\frac{2x-1}{2x+1} + 1\frac{3}{11} = \frac{3x+5}{3x-5}$.

(35) $4(x-1) = 3\frac{3}{4} + \frac{x-1}{2x}$

(36) $35(x-2)^2 = 26x - 55$.

(37) $x^2 = \frac{x+1}{5256}$.

(38) $\frac{b}{x} + \frac{x^2-b^2}{x+b} = x$.

(39) $\frac{x}{3} + \frac{3}{x} = \frac{x}{5} + \frac{5}{x}$.

(40) $(x-a)(x-b) + (x-b)(x-c) - (x-c)(x-a) = 0$.

$\therefore x^2 - ax - bx + ab + x^2 - bx - cx + bc - x^2 + cx + ax - ac = 0$.

$\therefore x^2 - 2bx + ab + bc - ac = 0$

$\therefore x^2 - 2bx = ac - ab - bc$

$\therefore x^2 - 2bx + b^2 = ac - ab - bc + b^2$

$\therefore x - b = \pm\sqrt{ac - ab - bc + b^2}$

$\therefore x = b \pm \sqrt{ac - ab - bc + b^2}$.

(41) $(x+2)(x-2)(x+8) = x(x-3)(x+16)$.

Various **problems** may be solved by means of quadratic equations. The following are examples:—

(1) If five times a certain number be subtracted from its square, the remainder will be 24. Find the number.

Let x = the number

Then x^2 = the square of the number

And $5x$ = five times the number

$\therefore x^2 - 5x = 24$.

We now have a quadratic equation, from which we can find x.

$x^2 - 5x + (\frac{5}{2})^2 = 24 + \frac{25}{4} = 1\frac{21}{4}$

$\therefore x - \frac{5}{2} = \pm 1\frac{1}{2}$

$\therefore x = \pm 1\frac{1}{2} + \frac{5}{2} = 8$ or -3

Hence the number is 8, or -3; or 8 only, if we reject negative quantities.

(2) Divide 15 into two parts, whose product shall be 36.

Let x = the first part

Then $15-x$ = the second part

and $x(15-x)$ = the product of the two parts

$\therefore x(15-x)=36$

$\therefore 15x-x^2=36$

$\therefore x^2-15x=-36$

$\therefore x^2-15x+(\frac{15}{2})^2=-36+\frac{225}{4}=\frac{81}{4}$

$\therefore x-\frac{15}{2}=\pm\frac{9}{2}$

$\therefore x=\pm\frac{9}{2}+\frac{15}{2}=12$ or 3

$\therefore 15-x=3$ or 12

Hence the two parts are 12 and 3

(3) I buy a piece of cloth for £3. If there had been 3 yards less in it, it would have cost a shilling more per yard. How many yards did it measure?

Let x = the number of yards of cloth

$\therefore \frac{60}{x}$ = price per yard in shillings.

$\frac{60}{x-3}$ = price per yard if there had been three yards less.

But the latter price is greater by 1s. than the former

$\therefore \frac{60}{x-3}=\frac{60}{x}+1$

$\therefore 60x=60(x-3)+x(x-3)$

$\therefore 60x=60x-180+x^2-3x$

$\therefore x^2-3x=180$

$\therefore x^2-3x+(\frac{3}{2})^2=180+\frac{9}{4}=\frac{729}{4}$

$\therefore x-\frac{3}{2}=\pm\frac{27}{2}$

$\therefore x=\pm\frac{27}{2}+\frac{3}{2}$

$=15$ or -12.

A negative answer is not admissible in this problem. Hence only the first value of x can be taken.

$\therefore$ No. of yards $=15$.

Exercise 8.

(1) If twice the square of a certain number be added to eight times the number, the sum is 42. Find the number.

(2) What number is that which, added to its square, makes 90?

(3) Divide 15 into two parts whose product shall be 50.

(4) Find two numbers, whose difference is 5 and product 84.

(5) Find two numbers whose sum is 13 and product 36.

(6) Divide 30 into two parts, so that one part shall be the square of the other.

(7) The sum of two numbers is 100, and their product is 2491. Find the numbers.

(8) Find a number which is less than the square of its third part by 40.

(9) Divide 20 into two parts such that the difference of their squares shall be 120.

(10) A certain number was added to the numerator of the fraction $\frac{5}{6}$, and afterwards to its denominator. The first result was three times as great as the second. Find the number.

Let $x =$ the number.

Then, if x be added to the numerator, we have $\frac{5+x}{6}$

and, if x be added to the denominator, we have $\frac{5}{6+x}$

But the former result is three times as great as the latter.

$$\therefore \frac{5+x}{6} = 3\left(\frac{5}{6+x}\right)$$

$$\therefore \frac{5+x}{6} = \frac{15}{6+x}$$

$$\therefore 30 + 11x + x^2 = 90$$

$$\therefore x^2 + 11x = 60$$

$$\therefore x^2 + 11x + (\tfrac{11}{2})^2 = 60 + \tfrac{121}{4} = \tfrac{361}{4}$$

$$\therefore x + \tfrac{11}{2} = \pm \tfrac{19}{2}$$

$$\therefore x = \pm \tfrac{19}{2} - \tfrac{11}{2}$$

$$= 4, \text{ or } -15.$$

Therefore the number required is 4

(11) A person bought a certain number of oxen for £90; but if he had bought one ox less for the same price, they would have cost a pound apiece more. Find the number of oxen.

(12) Two square columns contained 1521 men. One column consisted of 21 ranks more than the other. Required the number of men in each column.

(The following are taken from Government Examination Papers.)

(13) The sum of two numbers is 100 and their product 2400. Find the numbers.

(14) The difference of two numbers is 6, and if 47 be added to twice the square of the less, the sum will be equal to the square of the greater. Find them.

(15) The length and breadth of a rectangular room are measured with a defective foot-rule; the area appears to be $420\frac{1}{4}$ square feet, but is really 400 square feet. Find the error in the rule.

(16) A merchant sells two casks of wine for £76 5*s.*; one holds 5 gallons more than the other, and the price of each wine per gallon is in shillings the number of gallons in the cask which contains it. How many gallons are there in each cask?

(17) A man walked 8 miles and 1320 yards in a certain number of hours, less by one than the number of miles he walked in an hour: how long did he walk?

(18) 110 bushels of coal were equally divided amongst some poor persons; if each person had received one bushel more, he would have had as many bushels as there were persons. Find the number of poor.

(19) A man bought a horse for a certain sum, and having re-sold it for £119, found that he had gained as much per cent. as the horse cost him. What did he pay for it?

(20) A man, by walking at the rate of $\frac{1}{3}$ of a mile per hour above his ordinary rate, gains $\frac{3}{4}$ of an hour in 39 miles; what is his ordinary rate?

(21) The cost of an entertainment was £6, which was to have been divided equally among the party, but four of them leave

without paying, and the rest have each to pay 2*s.* 6*d.* extra in consequence. Of how many did the party consist?

(22) If each side of a square plot were enlarged by 10 yards, it would contain $1\frac{1}{2}$ acre more; find a side of the plot.

(23) One number is the square of another, and their sum equals six times the smaller of the two; find the numbers.

(24) The length of a garden exceeds its breadth by 50 yards; the garden contains 9375 yards: find its length and breadth.

(25) A square field contains 1 acre, 2 roods, 27 poles, $23\frac{1}{4}$ square yards; find the length and breadth of an oblong field, one of whose sides is as much longer than the side of the square as the other is shorter than it, and whose area contains 6400 square yards.

(26) The product of two numbers is 98, and the quotient, when one is divided by the other, is 2; find the numbers.

The general equation may be written in the form $ax^2 + bx + c = 0$; where a is the coefficient of x^2, b is the coefficient of x, and c is the term which does not contain x.

This equation may be reduced to a form in which the coefficient of x^2 is unity, by dividing each term by a. Hence the general equation can always be given in the form $x^2 + px + q = 0$.

We have already seen that in the latter equation—

$$x = -\tfrac{1}{2}p \pm \sqrt{\tfrac{1}{4}p^2 - q}.$$

Thus the two roots of this equation are—

$$-\tfrac{1}{2}p + \sqrt{\tfrac{1}{4}p^2 - q}$$

and $$-\tfrac{1}{2}p - \sqrt{\tfrac{1}{4}p^2 - q}$$

Adding these values we have—

$$\textbf{Sum of the Roots} = -p.$$

That is, *the sum of the roots is equal to the coefficient of x in the general equation, with its sign changed.*

Again, multiplying the two values of x, we have—

$$\begin{aligned}\textbf{Product of the Roots} &= (-\tfrac{1}{2}p)^2 - (\sqrt{\tfrac{1}{4}p^2 - q})^2 \\ &= \tfrac{1}{4}p^2 - (\tfrac{1}{4}p^2 - q) \\ &= q\end{aligned}$$

That is, *the product of the roots is equal to the term of the general equation which does not contain x.*

If α be the first root and β the second root, then we have—

$$\alpha + \beta = -p$$

and $$\alpha\beta = q.$$

The three following points should be noticed :—

(1) The quantity under the radix will vanish when $\frac{1}{4}p^2 - q = 0$; that is, when $\frac{1}{4}p^2 = q$; that is, when $p^2 = 4q$. The roots will then be *real* and *equal* quantities, since each will be equal to $-\frac{1}{2}p$.

(2) The quantity under the radix will be positive when $\frac{1}{4}p^2 > q$; that is, when $p^2 > 4q$. The roots will then be *real*, because a positive quantity has a square root. They will also be *different*, since either sign can be taken before the radix.

(3) The quantity under the radix will be negative when $\frac{1}{4}p^2 < q$; that is, when $p^2 < 4q$. The roots will then be *impossible*, because the square root of a negative quantity cannot be taken.

Hence, collecting these results, we find that :—

The roots are *real* and *different*, *real* and *equal*, or *impossible*, according as—

$$p^2 >, =, \text{or} < 4q.$$

An equation may be formed with any two given roots.

For let α, β, be the roots of the equation $x^2 + px + q = 0$.

Then, since $\alpha + \beta = -p$

$$\therefore\ p = -(\alpha + \beta)$$

Also $q = \alpha\beta$

$$\begin{aligned} \therefore\ x^2 + px + q &= x^2 - (\alpha + \beta)x + \alpha\beta \\ &= x^2 - \alpha x - \beta x + \alpha\beta \\ &= x(x - \alpha) - \beta(x - \alpha) \\ &= (x - \alpha)(x - \beta) \end{aligned}$$

Therefore the equation may be written—

$$(x - \alpha)(x - \beta) = 0$$

Hence, an equation may be formed with any given roots by substituting those roots for α and β in this form of the general equation.

For example, if it is required to form an equation with roots 3 and 5, we have $\alpha = 3$, and $\beta = 5$. Hence, the required equation will be—

$$(x-3)(x-5)=0$$

or, $$x^2-8x+15=0$$

Again, to form an equation with roots $\frac{1}{2}$ and -3, take $\alpha=\frac{1}{2}$, and $\beta=-3$. Then—

$$(x-\tfrac{1}{2})(x+3)=0$$

or, $$x^2-2\tfrac{1}{2}x-1\tfrac{1}{2}=0$$

or, $$2x^2-5x-3=0$$

Exercise 9.

Form the equations with roots—

(1) 10 and 2.
(2) 8 and -3.
(3) 5 and 5 (roots equal).
(4) 3 and -3.
(5) 11 and -1.
(6) 3 and -4.
(7) a and b.
(8) 2 and $\frac{1}{3}$.
(9) $\frac{1}{2}$ and $\frac{3}{4}$.
(10) $2\frac{1}{2}$ and $-1\frac{1}{2}$.
(11) $\frac{7}{8}$ and -1.
(12) -5 and -8.

IV. EQUATIONS CONTAINING SURDS.

Equations containing surd quantities are sometimes given to Pupil Teachers, though Surds are not included in the Pupil Teachers' Course as set down in the Schedule. They are, however, worked without much difficulty, as will be seen in the following examples.

(1) $$\sqrt{5x-6}=2x-3.$$

Square both sides of the equation. The square of the left-hand side is of course obtained by simply taking away the radix

$$\therefore\ 5x-6=4x^2-12x+9.$$

We now have an ordinary quadratic equation.

$$4x^2-17x=-15$$

$$\therefore\ x^2-\tfrac{17}{4}x+(\tfrac{17}{8})^2=-\tfrac{15}{4}+\tfrac{289}{64}$$

$$=\tfrac{49}{64}$$

$$\therefore\ x-\tfrac{17}{8}=\pm\tfrac{7}{8}$$

$$\therefore\ x=\pm\tfrac{7}{8}+\tfrac{17}{8}$$

$$=3,\text{ or }1\tfrac{1}{4}.$$

(2) $$\sqrt{3x+1}+2-\sqrt{6x-5}=1$$

$$\therefore \sqrt{3x+1}+1=\sqrt{6x-5}$$

Squaring both sides, we have—

$$3x+1+2\sqrt{3x+1}+1=6x-5.$$

Transpose the terms so as to have the surd quantity by itself on the right-hand side of the equation.

$$\therefore 3x-7=2\sqrt{3x+1}.$$

Squaring both sides, we have—

$$9x^2-42x+49=4(3x+1)$$
$$=12x+4$$
$$\therefore 9x^2-54x=-45$$
$$\therefore x^2-6x+9=4$$
$$\therefore x-3=\pm 2$$
$$\therefore x=5, \text{ or } 1.$$

(3) $$\sqrt{\frac{a+x}{a-x}}+\sqrt{\frac{a-x}{a+x}}=\sqrt{5}.$$

Squaring both sides, we get—

$$\frac{a+x}{a-x}+2\sqrt{\frac{a+x}{a-x}}\times\sqrt{\frac{a-x}{a+x}}+\frac{a-x}{a+x}=5.$$

$$\therefore \frac{a+x}{a-x}+\frac{a-x}{a+x}+2\sqrt{\frac{a+x}{a-x}}\times\sqrt{\frac{a-x}{a+x}}=5.$$

Now, by the principles of Surds, $\sqrt{m}\times\sqrt{n}=\sqrt{mn}$, and therefore $\sqrt{\frac{a+x}{a-x}}\times\sqrt{\frac{a-x}{a+x}}=\sqrt{\frac{(a+x)(a-x)}{(a-x)(a+x)}}=\sqrt{1}=1.$

$$\therefore \frac{a+x}{a-x}+\frac{a-x}{a+x}+2=5.$$
$$\therefore (a+x)^2+(a-x)^2=3(a^2-x^2)$$
$$\therefore a^2+2ax+x^2+a^2-2ax+x^2=3a^2-3x^2$$
$$\therefore 5x^2=a^2$$
$$\therefore x^2=\frac{a^2}{5}$$
$$\therefore x=\pm\sqrt{\frac{a^2}{5}}$$
$$=\pm a\sqrt{\tfrac{1}{5}}.$$

Exercise 10.

(Most of these examples are taken from Government Examination Papers.)

(1) $\sqrt{3x-5}=4$.

(2) $\sqrt{x+16}=2+\sqrt{x}$.

(3) $\sqrt{x-1}=\sqrt{x-9}$.

(4) $\sqrt{x+\sqrt{x-3}}=3$.

(5) $a+x+\sqrt{a^2+x^2}=b$.

(6) $\sqrt{x}+\sqrt{x+3}=\sqrt[5]{x+3}$.

(7) $\sqrt{x+8}+\sqrt{x+19}=11$.

(8) $\sqrt{2x}+\sqrt{2x-3}=3$.

(9) $\dfrac{\sqrt{a+x}+\sqrt{a-x}}{\sqrt{a+x}-\sqrt{a-x}}=2$.

(10) $\dfrac{1}{\sqrt{x+2}}=\frac{1}{2}\sqrt{3-x}$.

(11) $\sqrt{4a+x}+\sqrt{a+x}=2\sqrt{x-2a}$.

Squaring both sides, we have—

$$4a+x+2\sqrt{(4a+x)(a+x)}+a+x=4(x-2a)=4x-8a$$

$$\therefore 2\sqrt{(4a+x)(a+x)}=2x-13a$$

Squaring both sides, we have—

$$4(4a+x)(a+x)=4x^2-52ax+169a^2$$

$$\therefore 16a^2+20ax+4x^2=4x^2-52ax+169a^2$$

$$\therefore 72ax=153a^2$$

$$\therefore 8x=17a$$

$$\therefore x=2\tfrac{1}{8}a.$$

(12) $\sqrt{x-3}+\sqrt{x-5}=\sqrt{x}$.

Exercise 11.

(*Miscellaneous Examples.*)

(The following are mostly taken from Government Examination Papers.)

(1) Reduce $\frac{2a^2+ab-b^2}{a^3+a^2b-a-b}$ to lowest terms.

(2) Find the G. C. M. of x^3-x^2+x+3 and $x^4+x^3-3x^2-x+2$, and the L. C. M. of $x+2$, x^2-1; x^2+x-2.

(3) Simplify :—

$$\left(\frac{x+y}{x-y}\right)^2-\left(\frac{x-y}{x+y}\right)^2$$

(4) Simplify the expression :—

$$\left(\frac{1}{x}-\frac{1}{x^2+1}\right)\left(\frac{x^2+1}{x^2-1}-\frac{x^2-1}{x^2+1}\right)$$

(5) Show that the sum of the roots of the equation $x^2-px+q=0$ is p.

(6) Find the square root of $4x^4+4x^2y^2-12x^2z^2+y^4-6y^2z^2+9z^4$.

(7) Prove that—

$$(a^2+b^2)\div\left(\frac{1}{b}-\frac{1}{a}\right)-(a^2-b^2)\div\left(\frac{1}{b}+\frac{1}{a}\right)=\frac{2a^2b^2}{a-b}$$

(8) B and C can, together, do a piece of work in $1\frac{1}{2}$ hours; B alone can do it in 4 hours, and A in 2 hours. In what time will they do it if the three work together?

(9) Simplify :—

$$(a)\quad \frac{\frac{1}{3}(x+1\frac{1}{3})-\frac{2}{3}\left(1-\frac{3x}{4}\right)}{1\frac{2}{4}-\frac{1}{2}(x+4\frac{1}{2})}$$

$$(b)\quad \frac{2(x^2-\frac{1}{4})}{2x+1}+\frac{1}{2}$$

(10) If $ab(c+d-e-f)+cd(e+f-a-b)+ef(a+b-c-d)=0$, then $(a-c)(b-f)(e-d)=(a-e)(b-d)(c-f)$

(11) Find the G. C. M. of $x^3-9x^2+26x-24$ and $x^3-12x^2+47x-60$, and resolve it into factors.

(12) Divide $a^2b-bx^2+a^2x-x^3$ by $(a-x)(b+x)$.

(13) Find the Least Common Multiple of $x^4 + x^2y^2 + y^4$ and $x^3 - y^3$.

(14) Simplify :—

$$\frac{\dfrac{x^3 - a^3}{x^3 + a^3}}{\dfrac{(x-a)^2}{(x+a)^2}}$$

(15) Solve the equations :—

$$\frac{3x^2 - 27}{x^2 + 3} + \frac{90 + 4x^2}{x^2 + 9} =$$
$$2x^2 + 1 = 11(x + 2)$$

(16) Multiply $(a - b + c)$ by $(a + b - c)$, and say what is the value of the product (1) when $a = 9$, $b = 4$, $c = 3$; and (2) when $a = \frac{1}{2}$, $b = \frac{3}{2}$, $c = 1$.

(17) Solve the equation; $x - 5 - 4\left(\frac{3a}{2} - 4\right) = 3(15 - 2a)$

(18) Solve the equation; $\frac{5x}{8} - \frac{11x}{12} = \frac{7x}{9} - (x + 5)$

(19) Solve the equations; $7x + 4y = 17y$, $6x - 10y = 8$.

(20) A grocer bought 200 lbs. of tea and 1000 lbs. of sugar, the price of the sugar being $\frac{1}{6}$ of that of the tea. He sold the tea at a profit of 40 per cent., and the sugar at a loss of $2\frac{1}{2}$ per cent., gaining on the whole £9 9*s.* 7*d.* What were his buying and selling prices?

(21) Simplify: $\left(y + \frac{xy}{y - x}\right)\left(y - \frac{xy}{x + y}\right)\left(\frac{y^2 - x^2}{y^2 + x^2}\right)$

(22) Find the square root of $4a^4 + 4a^2b^2 - 12a^2c^2 + b^4 - 6b^2c^2 + 9c^4$.

(23) Solve the equations; $\frac{5x}{6} - \frac{3y}{7} = 2 = \frac{x}{2} - \frac{y}{7}$

(24) Solve the equation; $\frac{2x - 3}{x - 2} + \frac{2x - 1}{1 - x} = \frac{1}{6}$.

(25) Find the G. C. M. of $12x^4 - 14x^3 - 3x^2 + 4x + 1$ and $12x^4 - 22x^3 + x^2 + 6x + 1$.

(26) Solve the equations ;

$$\left.\begin{aligned} \frac{11x+7}{12} &= \frac{11y-2}{17} \\ \frac{x+y}{18} &= \frac{y-x+1}{5} \end{aligned}\right\}$$

(27) Solve the equation ;

$$23+\tfrac{3}{4}(5x-7)=(x+7)(x-5).$$

(28) If B give A 6*d.*, A will have twice as much as B ; and if B give A 6*s.*, A will have five times as much as B. How much has each ?

ANSWERS TO ALGEBRA.

Exercise 1 (p. 536).

(1) n ; $2x$; xyz ; $3mn$; $6ab$.
(2) $-n$; $4x^2y$; $-5ay^4$; $10mn^3$.
(3) $4x^5$; $-7ab^2$; $11x^6y$; $-8xy$.
(4) $-9x^7$; $-12x^3y^6$; $3x^9y^3z$; $-2xy^2$.
(5) $\frac{1}{4}xy^2$; $-\frac{3}{5}x^2y^5$; $\frac{2}{3}a^5b$; $-\frac{1}{5}m^6$.

Exercise 2 (p. 539).

(1) $x+1$. (2) $2a+3b$. (3) $2m-3$.
(4) $1-x$. (5) $5x-4y$. (6) $3x^2-3$.
(7) $7x-9y$. (8) x^2-4x+2. (9) x^2-3x+1.
(10) m^2-2m+1. (11) x^2-2x-4. (12) a^2+a+1.
(13) a^3+2a^2-1.

Exercise 3 (p. 544).

(1) $x=5$, $y=36$. (2) $x=3\frac{1}{2}$, $y=4$.
(3) $x=9\frac{2}{3}$, $y=8\frac{1}{3}$. (4) $x=-3\frac{1}{3}$, $y=4$.
(5) $x=3$, $y=5$. (6) $x=9$, $y=9$.
(7) $x=19$, $y=17$. (8) $x=4\frac{4}{13}$, $y=11\frac{12}{13}$.
(9) $x=5$, $y=3$. (10) $x=19$, $y=15$.
(11) $x=5\frac{23}{71}$, $y=3\frac{67}{71}$. (12) $x=70\frac{7}{16}$, $y=9\frac{1}{16}$.
(13) $x=7$, $y=11$. (14) $x=11$, $y=4$.

(15) $x = \frac{bc}{a+b}$, $y = \frac{ac}{a+b}$. (16) $x = \frac{n-m}{a-1}$, $y = \frac{am-n}{a-1}$.

(17) $x = 2$, $y = 3$. (18) $x = 7\frac{8}{9}\frac{3}{3}$, $y = 4\frac{8}{9}\frac{3}{3}$.

(19) $x = 12$, $y = 8$. (20) $x = a + b$, $y = a - b$.

(21) $x = \frac{1}{3}$, $y = 1$. (22) $x = 2$, $y = 3$.

(23) $x = 13$, $y = 3$. (24) $x = 60$, $y = 40$.

(25) $x = \cdot 02$, $y = 2 \cdot 9$. (26) $x = \frac{a^2 + b^2}{a + b}$, $y = \frac{a^2 + b^2}{b - a}$.

(27) $x = 5$, $y = 4$. (28) $x = 6$, $y = 7$.

Exercise 4 (p. 548).

(1) 30, 50. (2) 3, 5, 8. (3) 50 yrs., 10 yrs.

(4) $\frac{5}{8}$. (5) 30*s.*, £4. (6) 2*s.* 6*d.*, 2*s.*

(7) 5*s.*, 3*s.* (8) 48. (9) 80, 120.

(10) $\frac{6}{14}$. (11) 24. (12) 14.

(13) 3. (14) 12. (15) 8, 9, 10.

(16) 450 miles. (17) $10\frac{70}{161}$ ft., $6\frac{45}{77}$ ft. (18) $15\frac{1}{2}$ miles.

(19) £30, £20. (20) 505. (21) 36, 27.

Exercise 5 (p. 554).

(1) ± 8. (2) ± 3. (3) ± 2. (4) ± 1.

(5) ± 7. (6) $\pm \sqrt{2}$. (7) ± 4. (8) ± 3.

(9) $\pm \sqrt{\frac{19}{6}}$. (10) $\pm \sqrt{a+b}$. (11) $\pm \sqrt{10}$. (12) $\pm \sqrt{bc}$

Exercise 6 (p. 556).

(1) 3, or 1. (2) 8, or -2. (3) 3, or -11.

(4) 2, or -3. (5) 6, or 4. (6) 5, or 3.

(7) 8, or -2. (8) -5, or 1. (9) 7, or -4.

(10) 7, or -2. (11) 1, or -8. (12) 11, or -2.

Exercise 7 (p. 558).

(1) $\frac{3}{4}$, or 3. (2) $\frac{1}{2}$, or -1. (3) 2, or -4.

(4) 7, or -1. (5) 3, or 5. (6) $2\frac{1}{3}$, or -4.

(7) $-\frac{3}{7}$, or $-\frac{3}{5}$. (8) 11, or $-9\frac{1}{17}$. (9) 4, or $-3\frac{1}{15}$.

(10) $\frac{33}{125}$, or $-\frac{3}{5}$. (11) $\frac{1}{13}$, or $-\frac{1}{13}$. (12) $\frac{a}{2}$, or $-a$.

(13) 6, or $-5\frac{4}{5}$. (14) $\frac{3}{4}$, or $-\frac{1}{3}$. (15) $\frac{1}{2}a$, or $-2a$.
(16) 6, or -7. (17) 5, or $-2\frac{1}{2}$. (18) $\frac{3}{7}$, or -3.
(19) 25, or -30. (20) a, or b. (21) 16, or 6.
(22) 10, or 2. (23) 11, or -13. (24) $1\frac{1}{3}$, or $\frac{3}{5}$.
(25) 2, or -12. (26) 6, or $3\frac{1}{3}$. (27) $-a$, or $-b$.
(28) 2, or $\frac{12}{35}$. (29) 6, or $\frac{1}{3}$. (30) ± 6.
(31) 3, or $-\frac{40}{85}$. (32) ± 10. (33) 10, or $-\frac{11}{7}$.
(34) 5, or $-\frac{1}{6}$. (35) 2, or $\frac{1}{16}$. (36) $\frac{12}{5}$, or $\frac{16}{7}$.
(37) $\frac{1}{73}$, or $-\frac{1}{73}$. (38) 1. (39) $\pm\sqrt{15}$.
(40) $b \pm \sqrt{ac - ab - bc + b^2}$. (41) 8, or $\frac{4}{5}$.

Exercise 8 (p. 562).

(1) -7, or 3. (2) 9, or -10. (3) 10, 5.
(4) 7, 12. (5) 4, 9. (6) 25, 5.
(7) 53, 47. (8) 24. (9) 13, 7.
(10) 4. (11) 10. (12) 225, 1296.
(13) 60, 40. (14) 17, 11. (15) $\frac{1}{21}$ ft.
(16) 25, 30. (17) $2\frac{1}{2}$ hrs. (18) 11.
(19) £70. (20) 4 miles per hour. (21) 16.
(22) 358 yards. (23) 5, 25. (24) 125 yds, 75 yds.
(25) 131·23 yds.; 48·77 yds. nearly. (26) 14, 17.

Exercise 9 (p. 566).

(1) $x^2 - 12x + 20 = 0$. (2) $x^2 - 5x - 24 = 0$.
(3) $x^2 - 10x + 25 = 0$. (4) $x^2 - 9 = 0$.
(5) $x^2 - 10x - 11 = 0$. (6) $x^2 + x - 12 = 0$.
(7) $x^2 - (a + b)x + ab = 0$. (8) $3x^2 - 7x + 2 = 0$.
(9) $8x^2 - 10x + 3 = 0$. (10) $4x^2 - 4x - 15 = 0$.
(11) $8x^2 + x - 7 = 0$. (12) $x^2 + 13x + 40 = 0$.

Exercise 10 (p. 568).

(1) 7. (2) 9. (3) 25.
(4) 4. (5) $\frac{b(2a - b)}{2(a - b)}$. (6) $\frac{4}{7}$.
(7) 17 (8) 2. (9) $\frac{4a}{5}$.

(10) 2, or -1. (11) $2\frac{1}{3}a$. (12) $\frac{8 \pm \sqrt{76}}{3}$

Exercise 11 (p. 569).

(1) $\frac{2a-b}{a^2-1}$

(2) G. C. M. $= x+1$;
L. C. M. $= x^3+2x^2-x-2$.

(3) $\frac{8xy(x^2+y^2)}{(x^2-y^2)^2}$ (4) $\frac{2x}{x^4-1}$ (6) $2x^2+y^2-3z^2$.

(8) $\frac{2}{7}$ hr. (9) $\frac{3x}{1-x}$; x.

(11) $x^2-7x+12$; $(x-4)(x-3)$. (12) $a+x$.

(13) $x^5-x^4y+x^3y^2-x^2y^3+xy^4-y^5$.

(14) $\frac{x^3+2ax^2+2a^2x+a^3}{x^3-2ax^2+2a^2x-a^3}$ (15) 3; 7, or $-1\frac{1}{2}$.

(16) $a^2-b^2+2bc-c^2$; 80; 0.

(17) 34. (18) 72. (19) 13; 7.

(20) 2s. 6d., 5d.; 3s. 6d., $4\frac{1}{2}$d. (21) $\frac{y^4}{x^2+y^2}$

(22) $2a^2+b^2-3c^2$. (23) 6, 7. (24) 4, or -1.

(25) $4x^2-2x-1$. (26) 7, 11. (27) 8, or $-6\frac{2}{3}$.

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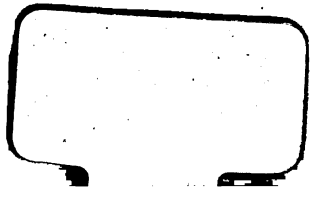
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